UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

July 10, 2007

REPLY TO THE ATTENTION OF:
SR-6J

Mr. Jerry C. Winslow
Principal Environmental Engineer
Xcel Energy
414 Nicollet Mall (Ren. Sq. 8)
Minneapolis, Minnesota 55401

RE: Final revisions to the Revised HHRA
Ashland/NSP Lakefront Superfund Site

Dear Mr. Winslow:

In accordance with the Administrative Order on Consent (AOC), CERCLA Docket No. V-W-04-C-764, Section X, Subparagraph 21(c), the United States Environmental Protection Agency (EPA) is modifying the Revised Human Health Risk Assessment (HHRA) submission to cure certain deficiencies. By letter dated December 22, 2006, EPA previously provided Northern States Power Company (NSPW), (d.b.a. Xcel Energy) a notice of deficiency regarding the HHRA giving NSPW 21 days to cure the deficiency by incorporating EPA's modifications. EPA's comments were not adequately addressed; therefore, EPA invokes its right to modify a submission pursuant to Subparagraph 21(c). By this letter EPA is providing further notice of deficiency and giving NSPW 21 days to cure the deficiency by incorporating the modifications as shown in the attached HHRA document. Within 21 days of the receipt of this letter, the appropriate revisions to the HHRA need to be incorporated and submitted to EPA. Additional modifications provided below will also need to be incorporated.

In addition, all supporting documents (Tables, Appendices, etc.) should be revised based on the modifications to the HHRA document. The supporting documents need to be consistent with the HHRA.

1. The most recent version of the Remedial Action Objectives (RAOs) and human health risk components must be incorporated into the HHRA for both accuracy and consistency.

2. The HHRA needs to be updated and revised to address a lower Lake Superior level and potential exposures to contaminated sediments that were previously excluded due to being beyond a specified depth. Additionally, some sediments may not be completely exposed and a soil exposure pathway may need to be considered.

3. It is imperative that the findings of the Newfields memo dated 5/14/2007 be incorporated into the final draft HHRA. These findings were related to a) trespasser scenario of direct contact with product and oily sheens on surface water infiltrating into the former Waste Water Treatment Plant (WWTP), b) construction worker exposures via dermal contact with ditch water with oily sheens and product, c) recreational exposures to oily sheens and product on surface water. These pathways of the HHRA remain deficient for

evaluating inhalation exposures to contaminants coming off of surface water and groundwater.

4. All versions of the HHRA have not been corrected to describe reports of naturally released free product in surface water and continue to incorrectly state that no-site related COPC have been found in surface water.

5. Access to the WWTP remains unrestricted, though the HHRA states otherwise. This needs to be corrected.

6. The HHRA continues to state that 1.0E-04 cancer risk falls within an acceptable range. This need to be corrected.

7. The results and findings of the 1998 SEH HHRA have yet to be fully incorporated into the final draft HHRA. Where the SEH information was added to the January 2007 HHRA (Section 6.5), it contains many errors and inaccuracies, and the table on page 6-12 has a number of errors, along with missing data.

8. The conclusions on page 7-1 need to be updated to reflect the needed corrections, as well as the new risk findings.

Please make sure the revised submission shows the changes that were incorporated. If you have any questions or would like to discuss things further, please contact me at (312) 886-1999.

Sincerely,

Scott K. Hansen
Remedial Project Manager

cc: Dave Trainor, Newfields
Jamie Dunn, WDNR
Omprakash Patel, Weston Solutions, Inc.
Henry Nehls-Lowe, DHFS
Ervin Soulier, Bad River Band of the Lake Superior Chippewa
Melonee Montano, Red Cliffe Band of the Lake Superior Chippewa

FINAL DRAFT REPORT

HUMAN HEALTH RISK ASSESSMENT - ASHLAND/NORTHERN STATES POWER LAKEFRONT SUPERFUND SITE

Prepared for

Northern States Power Company - WI
1414 West Hamilton Avenue
Eau Claire, WI 54701

January 25, 2007

URS

Milwaukee County Research Park
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25688375.70000

The purpose of the baseline human health risk assessment (HHRA) is to provide a risk-based interpretation of the data collected during the RI and to provide conservative estimates of potential human health risks posed by chemicals that are present at or migrating from the Site.

APPROACH

This HHRA was completed using the data collected as part of the remedial investigation (RI) along with historical data from work previously completed by the Wisconsin Department of Natural Resources (WDNR) and the Wisconsin Department of Health and Family Services (WDHFS). The methodology for completing the HHRA follows guidance presented in *Risk Assessment Guidance for Superfund (RAGS): Volume I. Part A – Human Health Evaluation Manual* (USEPA, 1989) and several more recent regulatory guidance documents and resources as appropriate such as:

- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (OSWER 9355.4-24, March 2002)(USEPA, 2002a);
- *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment* (EPA/540/R/99/005, OSWER 9285.7-02EP, PB99-963312, July 2004)(USEPA, 2004a);
- *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (OSWER 9285.6-10 December 2002)(USEPA, 2002b);
- *Exposure Factors Handbook* (EPA/600/P-95/002) August, 1997 (USEPA, 1997a); and
- A summary of up-to-date guidance and screening criteria presented in http://risk.lsd.ornl.gov/homepage/rap_docs.shtml, (Oak Ridge National Laboratory [ORNL], On-line).

SITE DESCRIPTION

The Site is located in S 33, T 48 N, R 4W in Ashland County, Wisconsin, shown on **Figure 1**. The Site consists of property owned by Northern States Power Company-Wisconsin (NSPW), a portion of Kreher Park, and sediments in an offshore area adjacent to Kreher Park. Existing site features showing the boundary of the Site are shown on **Figure 2**. The Site includes the following:

- NSPW's property (a former manufactured gas plant [MGP]), and potentially the areas beneath residences located on the upper bluff,

- Potentially the areas including a school, a playground, and a church (also located on the upper bluff);
- Soils along the flat terrace adjacent to the Chequamegon Bay shoreline including Kreher Park (filled lakebed areas north of the bluff face);
- Other areas of the filled former lakebed not within the Kreher Park boundary including a former City Wastewater Treatment Plant (WWTP) and buildings, grassed areas, and boat storage; and
- Impacted sediment in the lake adjacent to the filled lakebed area north of Kreher Park.

Population and Land Use

The Site is located in Ashland County, Wisconsin. Ashland County has a population of 16,866 and covers a land area of 1,047 square miles. The City of Ashland (population 8,620 based on the 2000 Census) is the largest city in Ashland County, as well as the county seat. The Bad River Indian Reservation, an area of 200 square miles, is located entirely within Ashland County and has a population of 1,538.

According to census estimates, the population of Ashland County and the City of Ashland have changed little since 1990. Ashland County grew by 3.3 percent between 1990 and 1999 (16,307 to 16,866). The City of Ashland dropped in population by 0.8 percent (8,695 to 8,620). This is consistent with the limited population growth in the region over the last 20 years.

Residents are served by the city's municipal water supply, which is provided from Chequamegon Bay surface water. The surface water intake is located in approximately 23 feet of water and is approximately one mile northeast of the Site. The area is located in the Lake Superior Lowland Physiographic Province characterized by flat to undulating topography underlain by red glacial clay (Miller Creek Formation). Uplands lie to the south of Ashland and are characterized by rolling hilly topography and underlain by sand and gravel soils (Copper Falls Formation).

Geological and Hydrogeological Setting

The filled ravine at the upper bluff is a former drainage feature that begins near the NSPW administration building fronting on Lakeshore Drive, and deepens and widens to the north **(Figure 3)**. The mouth of the ravine opens to Kreher Park through the bluff face at the north end of the gravel storage yard. The maximum depth of fill in the ravine at the mouth is approximately 33 feet.

The Copper Falls Aquifer is a confined, variably coarse to fine-grained sand (reworked glacial till) that underlies the entire Lakefront site **(Figure 4)**. The formation is overlain by the surficial Miller Creek Formation, which is a lacustrine clay to silt till unit. At the NSPW property, the Miller Creek Formation has a maximum thickness of about 35 feet; the thinnest portion of the unit is at the mouth of the former ravine, at approximately four feet.

Surficial soils at the Site are underlain by a variety of fill materials, including wood waste (slabs and sawdust), solid waste (including concrete, bricks, bottles, steel, wire, and cinders), and earthen fill (including a buried clay berm along the shoreline on the northeast side of the Site near the former WWTP). The fill materials at Kreher Park are underlain by a variably 0 to 5.5 foot thick layer of beach sand separating the fill from the underlying Miller Creek Formation. Geology of the upper bluff area in the vicinity of the former ravine consists of earthen fill materials, with clay soils of the Miller Creek Formation on the flanks of the former ravine. The ravine fill unit consists of silty clay fill material mixed with ash, cinders, slag, and fragments of bricks, concrete, glass, wood, and other solid waste. The thickness of the fill diminishes to less than three feet beyond the flanks of the ravine to the east and west. Offshore geology consists of a discontinuous layer of submerged wood chips on the lake bottom underlain by variably fine to medium grained sediments. The sediments are underlain by silts and clays of the Miller Creek Formation. The Copper Falls Formation was not encountered during earlier investigations of the offshore sediments. Consequently, the thickness of the Miller Creek Formation below the bay is unknown.

Surface Water Features

The Site is located on the shore of Chequamegon Bay. Regional surface water drainage flows to the north through Fish Creek and several small unnamed creeks and swales into Chequamegon Bay. Surface water at the Site flows either to the City of Ashland storm sewer system, or discharges directly to Chequamegon Bay.

Information provided by the City of Ashland's Department of Public Works indicates that the City had a combined storm and sanitary sewerage system until the early to mid-1980s. The storm sewer system was separated from the sanitary system at that time to reduce flow to the former WWTP. In the past, storm water discharged directly to Chequamegon Bay through three known outfalls within the Site. Those outfalls have been closed and stormwater is now re-routed to a discharge point east of the Site.

GROUNDWATER USE

Groundwater is present in both a shallow aquifer and a confined deep aquifer. Currently the shallow groundwater is not used as a potable water source. There are two artesian wells in the Site vicinity that draw water from the Copper Falls aquifer, which is a deep aquifer separated from the shallow groundwater by the Miller Creek Formation (URS, 2005; ATSDR, 2003). The City of Ashland temporarily closed these wells for public use in August 2004. To date water from these wells have met all federal and state safe drinking water standards. Water from these artesian wells is considered safe to drink as Site-related chemicals have not been detected in these wells at levels of concern (ATSDR, 2003).

Except for the two artesian wells at Kreher Park, the Copper Falls aquifer is not used for drinking water and is not considered a source of human exposure. Shallow groundwater at the Site is not a drinking water source for the City of Ashland. Therefore, there are no known receptors to shallow groundwater beneath the Site.

Current and Potential Future Land Use Patterns

The upland area (upper bluff/ravine area) is primarily used for industrial or commercial purposes. Portions of the Site (e.g., the abandoned WWTP) are subject to trespassing activities. These areas, some of which are public streets, are readily accessible to the public although they are generally covered by clean fill or roadways.

The area near the lakefront is zoned conservancy district; i.e., acceptable for use as parkland. The filled lakebed portions of the Site are comprised of City parkland (Kreher Park). The area is readily accessible by the public and a majority of the Kreher Park area of the Site is mowed and maintained for public use. Kreher Park and the impacted sediments are surrounded by facilities that draw the public to the lakefront—a city marina, public swimming beach, a boat ramp and a recreational vehicle (RV) park and campground. Warning buoys also prohibit boats into the affected area.

According to the Ashland Wisconsin Waterfront Development Plan, the City has future plans for expanding the RV park, located immediately adjacent to the Ashland Lakefront property to the east. The plan proposes that the swimming beach will be retained but the RV park will be relocated to the Clarkson Dock farther to the east. The plan proposes that the existing RV park land will be redeveloped into a parking lot and an interpretive center for the ore freighter and/or the Great Lakes Shipping and Mining Museum.

DATA REVIEW PROTOCOL

RI analytical and field data were first compiled. Validated data were entered into the USEPA-specified database and tabulated for use. The data from previous sampling efforts and this RI were reviewed to:

- Identify the nature and extent of Site-related chemical; and
- Evaluate the usability, including any uncertainties associated with the data.

Data Tabulation

To facilitate the data evaluation process, the analytical results were tabulated as follows:

- The analytical data were divided into groups by sample location identification numbers, sample collection dates, sampling zone, sampling areas, and environmental media of concern.
- Analytical results were reported in the text, tables and figures using a consistent and conventional unit of measurement such as microgram per liter (µg/L) for groundwater and surface water analyses, milligrams per kilogram (mg/kg) for soil and sediment analyses, and milligrams per cubic meter (mg/m^3) for air analyses.

ANALYTICAL DATA USED TO EVALUATE RISK

Soil

Both surface and subsurface soil from several historical sampling events were evaluated in this HHRA. Data from sampling events completed between 1994 and 2005 were evaluated for inclusion in the HHRA. In general, all data from the previous investigations were used in the HHRA. In addition, a separate evaluation was performed by excluding chemical concentrations exceeding the soil saturation limit (Csat) in the derivation of concentration terms. This evaluation was prepared in response to review comments on the draft HHRA report. Information regarding this evaluation is presented in **Attachment H.**

Tables 1 to **5** present the surface and subsurface soil sample locations used for this evaluation by receptor. These tables also define the source of each data point used in the evaluation. **Table 2-6** of the RI report identifies the analytical parameters completed for soil. **Tables 4-8A** and **4-8B** of the RI report provides a summary of the analytical results for surface and subsurface soil. **Figure 5** graphically presents the sample locations selected to evaluate human receptors at the Site.

Sediment

The sediment data used to evaluate human receptors was selected based on those areas in Chequamegon Bay that are associated with human activity and are at depths that are likely to be contacted. Waders are typically assumed to come in contact with surface sediments only when evaluating exposures associated with a wading scenario. For this HHRA, sediment data between 0 to 2 foot in depth and with 4 feet or less of surface water cover were used in response to review comments on the draft HHRA Report.

These data were data selected based on a conservative assumption that waders may come in contact with sediments at depths when collecting wood. .

In addition, it was also assumed that sediment exposures could occur during surface water exposures. In this instance chemicals that are adsorbed on suspended sediment particles are assumed to be available for contact. However, there are no measured concentrations for this data set. Instead, a contact rate was developed based on the total suspended solids measurement of surface water using the equation below.

$$\text{Sediment Ingestion Rate}\left({}^{\text{mg}}\!/_{\text{hour}}\right) = \text{Surface Water Ingestion Rate}\left({}^{\text{mL}}\!/_{\text{hour}}\right) \times \text{Total Solids}\left({}^{\text{mg}}\!/_{\text{mL}}\right)$$

Table 6 presents the sediment data used for this HHRA. **Table 2-6** of the RI report identifies the analytical parameters completed for sediment. **Table 4-9** of the RI report provides a summary of the analytical results for sediment. **Figure 5** outlines those locations that were selected to evaluate human receptors at the Site.

Surface Water

It was assumed that all surface water within Chequamegon Bay could be accessed during recreational activities; therefore, analytical data collected in 1998 and 2005 were evaluated for use in the HHRA. However, unfiltered grab samples collected within the Chequamegon Bay inlet were used to evaluate surface water exposures.

Table 7 identifies those sample data by sampling event that were used to evaluate exposure to surface water. **Table 2-6** of the RI report identifies the analytical parameters completed for surface water. **Table 4-11** of the RI report provides a summary of the analytical results for surface water. **Figure 5** shows those surface water locations that were selected to evaluate human receptors at the Site.

Air

Soil Vapor

Soil vapor samples were collected from soil vapor probes installed in the uppermost water-bearing unit in the vicinity of the former MGP facility. These samples were collected to provide data that were used to evaluate potential vapor migration and to ensure that soil vapors are not migrating off-site through subsurface soil towards adjacent private properties and into residential structures.

Table 8 presents the soil vapor data used for the HHRA. **Table 2-7** of the RI report identifies the analytical parameters completed for soil vapor. **Table 4-12** of the RI report provides a summary of the analytical results for soil vapor. **Figure 5** presents locations selected to evaluate human receptors at the Site.

Indoor Air Vapor Investigation

An indoor air sample was collected to evaluate the potential for vapor migration into the existing NSPW Service Center building, which overlies impacted soil in the backfilled ravine. The indoor air investigation was designed to evaluate the chemicals present in indoor air and sub-slab soil vapors to determine if this area is being impacted by soil vapor migration and intrusion.

Table 8 presents the indoor air data used for the HHRA. **Table 2-7** of the RI report identifies the analytical parameters completed for indoor air. **Figure 5** presents those locations selected to evaluate human receptors at the Site.

Biota

Several species of fin fish were collected at the Site. However, for the HHRA only the edible portion of the following three were assumed to be consumed on a consistent basis. These fin fish include:

- Shorthead Redhorse (*Moxostoma macrolepidotum*)
- Walleye (*Stizostedion vitreum*)
- Rainbow Smelt (*Osmerus mordax*)

It was assumed that the sample as prepared for sampling corresponded to the edible portion of the fish. Fish were prepared as indicated below.

- Eight whole fish composite samples of smelt were collected from the Site and prepared as if for frying, i.e. their heads and entrails removed.
- Walleye were filleted (the skin was removed)
- Shorthead redhorse were processed as for smoking or pickling, i.e. only the head and entrails were removed.

Table 9 lists the fish samples used for this HHRA. **Table 2-6** of the RI report identifies the analytical parameters completed for fish tissue. **Figure 6** illustrates the locations selected to evaluate human receptors at the Site.

Identification of Chemicals of Potential Concern

The procedures used for selecting COPCs evaluated in the baseline HHRA are summarized in the following sections.

Risk-Based Screening Approach

The maximum detected concentration of a chemical was compared with chemical- and medium-specific risk-based screening concentrations (RBSCs), defined as concentrations that are not expected to result in any adverse impact based on exposure conditions which served as the basis for the calculation. A chemical was selected as a COPC if its maximum detected concentration value exceeds the RBSC.

For purposes of this project, the preliminary remediation goals (PRGs) derived by the USEPA Region 9 (USEPA, 2004b) were adopted as the primary source of RBSCs because they are based on conservative assumptions of exposure scenarios. In addition, the use of these PRGs for screening purposes is considered to be common practice by USEPA Region 5.

Deleted: The selected RBSCs for radionuclides cesium-137 and lead-210 were calculated using conservative default exposure parameter values and the PRG calculator provided on the ORNL website (ORNL, 2006) ¶

For those chemicals lacking an RBSC (i.e., PRG or risk-based concentration [RBC]) the standard practice of selecting surrogate chemicals based on similarities in structure was used to determine if a chemical should be included as a COPC. The surrogates used are identified in **Tables 10** to **18.**

It should also be noted that RBSCs that are protective of noncarcinogenic effects were adjusted by a factor of 0.1 (i.e., divided by a factor of 10) to account for possible additive effects of multiple chemicals. All RBSCs for the protection of carcinogenic effects are based on a target cancer risk of 1E-06.

Sources of the RBSCs used for this project are presented below by media of concern.

	PRG				RBC	AWQC	VI
	Industrial Soil	**Residential Soil**	***Tap Water***	***Ambient Air***	**Fish *Tissue***	**Surface Water *Ingestion***	**Target Indoor Air *Concentration***
Chemicals in Soil	×	✓					
Chemicals in Indoor Air/Soil Gas							^
Chemicals in Surface Water						·	
Chemicals in Sediment		·					
Chemicals in Fish Tissue					✓		

PRG – USEPA Region 9 Preliminary Remediation Goal (October 2004) (USEPA, 2004b)

RBC – USEPA Region 3 Risk-based Concentrations (October 2005) (USEPA, 2005a)

AWQC – USEPA National Recommended Water Quality Criteria (20026) for human health (water and organism) (USEPA, 2006a).

VI – Evaluating The Vapor Intrusion To Indoor Air Pathway From Groundwater and Soils (USEPA 2001b).

COPC Summary

The COPCs identified for this HHRA are primarily metals, SVOCs, and limited VOCs. A summary of the COPCs by receptor and medium is presented below. **Tables 10 to 19** present the detail screening summary tables by receptor and medium.

Chemical	Residential				Commercial/Industrial: General Industrial Worker		Commercial/Industrial: Maintenance Worker	Construction Worker	Recreational: Recreational User	Recreational: Swimmer Wader		Recreational: Fisherman
	SS & SB	SS	S:0-3	IA	SS	IA	SS	SS & SB	SS	SD	SW	Fish
Inorganics												
Antimony										×		
Arsenic	×	×	×		×		×	×	×			
Cadmium									×			
Iron										×		
Lead	×	×	×				×	×	×			
Manganese										×		
Thallium	×								×			
Vanadium										×		
SVOCs												
1-Methylnaphthalene	×		×					×		×		×
2-Methylnaphthalene	×							×		×		
Acenaphthene	×							×				
Benzo(a)anthracene	×		×				×	×	×	×		×
Benzo(a)pyrene	×	×	×		×		×	×	×	×		×
Benzo(e)pyrene												×
Benzo(b)fluoranthene	×		×				×	×	×	×		×
Benzo(k)fluoranthene	×		×					×	×	×		
Chrysene	×							×				
Dibenzo(a,h)anthracene	×		×					×				×
Dibenzofuran	×							×				×
Fluoranthene	×		×					×				
Fluorene	×							×				
Indeno(1,2,3-cd)pyrene	×		×				×	×	×	×		
Naphthalene	×		×					×		×		
Phenanthrene	×											
Pyrene	×		×					×				
VOCs												
1,2,4-Trichlorobenzene	×							×				
1,2,4-Trimethylbenzene	×		×			×		×				
1,3,5-Trimethylbenzene	×		×					×				

	Residential				Commercial/Industrial				Recreational			
					General Industrial Worker		Maintenance Worker	Construction Worker	Recreational User	Swimmer Wader		Fisherman
Chemical	SS & SB	SS	S:0-3	IA	SS	IA	SS	SS & SB	SS	SD	SW	Fish
1,4-Dichlorobenzene						×						
Benzene	×		×			×		×				
Ethylbenzene								×				
n-Butyl benzene								×				
sec-Butyl benzene								×				
Carbon tetrachloride						×						
Toluene								×				
Trichloroethylene						×						
Xylenes (total)	×							×				

Notes:
SS – surface soil
SB – subsurface soil
S:0-3 – soil (0 to 3 foot depth)
IA – indoor air
SD – sediment
SW – surface water

Receptors and Exposure Scenario

Presented below is an overview of populations of potential concern selected for further evaluation in this HHRA.

Exposure to COPCs in Soil

Residential Land Use Scenario: Child and Adult Residents

Upper Bluff - There is a residential area located upgradient from the Kreher Park area of the Site on the upper bluff area near the former ravine. Described below were three exposure scenarios assumed in this HHRA for the residential receptors:

- Exposure to surface (0-1 ft) and subsurface soil (1-10 feet bgs) This assumption was made because new construction would involve excavation of soil for the construction of basements. This scenario represents the worst case for residential receptors, but is not likely to be the actual scenario associated with the Site.
- Exposure to surface soil The residential neighborhoods adjacent to the Site are established neighborhoods and are expected to remain in the future. In an established residential setting and without intrusive activities, receptors would most likely be exposed to surface soil only.
- Exposure to soil in 0-3 ft bgs For informational purposes, COPCs in soil between 0 and 3 ft bgs were also considered for residential receptors based on the assumption that receptors could potentially be exposed to soil in 0-3 ft bgs when performing landscaping or gardening activities.

For the purpose of this HHRA, child and adult residents are assumed to be exposed to COPCs in soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Recreational Use Scenario: Child, Adolescent and Adult Visitors

Kreher Park is now comprised of City parkland. Child, adolescent and adult visitors are assumed to be exposed to COPCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Industrial/Commercial Land Use Scenario: Maintenance Workers

Although the Final RI/FS Work Plan (URS, 2005) indicated maintenance workers currently access the Site, additional information collected during the implementation of the RI/FS Work Plan indicates that City workers and utility maintenance personnel do not access the Site. However, the City may develop the existing marina and expand it into the affected area for recreational use. Therefore, a potential future maintenance worker was considered a receptor to surface soil at Kreher Park and the unpaved portions of the Upper Bluff area. It is conservatively assumed that maintenance workers may be exposed to COPCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Industrial/Commercial Land Use Scenario: General Industrial Workers

Except for the NSPW facility, no other industrial/commercial facilities exist within the Site. Although the potential for exposure to occur is expected to be low, general workers are assumed to be exposed to COPCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Industrial/Commercial Land Use Scenario: Construction Workers

Upper Bluff and Kreher Park - It is conservatively assumed that construction activities could take place at every area included in this evaluation and it is possible for construction workers to be exposed to COPCs detected in surface and subsurface soil samples collected from the Site via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways. For this HHRA subsurface soil is defined as a depth of 10 feet or less, which is a conservative estimate of the limit to which construction activities may occur based on the current and proposed future land use at the Site.

For informational purposes, a hot spot analysis was performed for construction worker using soil data collected from the Former Coal Tar Dump. The results of this analysis are presented in Section 6.6.

Exposure to COPCs in Indoor Air – Residents and Industrial Workers

Upper Bluff - There is a residential area located upgradient from the Kreher Park area of the Site on the upper bluff area, near the former ravine. For the purpose of this HHRA, child and adult residents are assumed to be potentially exposed to COPCs volatilizing from soil and groundwater and entering the residences located near the ravine. In addition, potential exposures to COPCs in indoor air were also evaluated for industrial workers who may enter the NSPW service center/vehicle maintenance building periodically.

Exposure to COPCs in Groundwater

Trespassing Land Use Scenario: Trespassers

The RI/FS Work Plan indicated that groundwater in the seep area was a potential exposure point for trespassers. However, this exposure point has been eliminated because the seep area was capped as part of the 2002 interim action response (URS, 2002). Therefore, this exposure pathway is no longer complete and was not quantitatively evaluated in the HHRA.

Another potential point of exposure to groundwater is the former WWTP building where groundwater has infiltrated into the basement. The building is locked and the perimeter is fenced with warning signs posted. A quantitative evaluation for the potential trespasser exposures to the indoor air and water inside the former WWTP building was not performed due to the lack of data.

Residential and Industrial/Commercial Land Use Scenarios

Groundwater is present in both a shallow aquifer and a confined deep aquifer. Currently the shallow groundwater is not used as a potable water source. There are two artesian wells in the Site vicinity. The City of Ashland temporarily closed these wells for public use in August 2004. To date water from these wells have met all federal and state safe drinking water standards. Water from these artesian wells is considered safe to drink as Site-related chemicals have not been detected in these wells at levels of concern (ATSDR, 2003). Therefore, there are no known receptors to shallow groundwater beneath the Site.

Exposure to COPCs in Surface Water and Sediments

Recreational Use Scenario: Adolescent and Adult Visitors

Kreher Park and Chequamegon Bay Sediments – The Site is surrounded by facilities that draw the public to the lakefront – a City marina, public swimming beach, a boat ramp and an RV park and campground. Adolescent and adult visitors are assumed to be exposed to COPCs in surface water and sediments via incidental ingestion and dermal contact pathways while swimming, wading, fishing, or boating. However, only risks associated with swimming and wading activities were quantified in the HHRA. This is because they represent activities that have the greatest contact with impacted media and are considered more conservative than exposures associated with fishing and boating.

Exposure to COPCs in Fish Tissue

Subsistence Fishing Scenario: **Adult Subsistence Fisher**

Impacted Sediment Areas – Adult subsistence fishers were selected as the fishing receptors because there are two Chippewa Bands (the Bad River Band and the Red Cliff Band of Lake Superior Chippewa) who may use Chequamegon Bay as their source of fish.

Presented below is an overview of receptors of potential concern selected for further evaluation in this HHRA. Potential receptors are discussed based on medium of interest (i.e., soil, sediment, surface water, biota, and air). A detailed discussion of the risks associated with each receptor population is presented in **Section 5.1.**

SUMMARY OF PATHWAYS EVALUATED IN HHRA						
Receptor Pathway	**Media of Interest[a]**					
	Surface Soil	**Subsurface Soil**	**Sediment**	**Surface Water**	**Indoor Air**	**Biota**
Industrial Worker Exposure Scenario:						
Inhalation of airborne COPCs	FMGP				SCB	
Incidental ingestion of COPCs	FMGP					
Dermal contact with COPCs	FMGP					
Construction Worker Exposure Scenario:						
Inhalation of airborne COPCs	KP FMGP	KP FMGP				
Incidental ingestion of COPCs	KP FMGP	KP FMGP				
Dermal contact with COPCs	KP FMGP	KP FMGP				
Maintenance Worker Exposure Scenario:						
Inhalation of airborne COPCs	KP UB	KP UB				
Incidental ingestion of COPCs	KP UB	KP UB				
Dermal contact with COPCs	KP UB	KP UB				
Recreational Exposure Scenario/Children:						
Inhalation of airborne COPCs	KP					
Incidental ingestion of COPCs	KP					
Dermal contact with COPCs	KP					
Recreational Exposure Scenario/Adolescents:						
Inhalation of airborne COPCs	KP					
Incidental ingestion of COPCs	KP					
Dermal contact with COPCs	KP					
Recreational Exposure Scenario/Adults:						
Inhalation of airborne COPCs	KP					
Incidental ingestion of COPCs	KP					
Dermal contact with COPCs	KP					

SUMMARY OF PATHWAYS EVALUATED IN HHRA						
Receptor Pathway	**Media of Interest**[a]					
	Surface Soil	**Subsurface Soil**	**Sediment**	**Surface Water**	**Indoor Air**	**Biota**
Recreational Exposure Scenario/Swimmer & Wader/Adults:						
Incidental ingestion of COPCs			KP CB	KP CB		
Dermal contact with COPCs			KP CB	KP CB		
Recreational Exposure Scenario/Swimmer & Wader/Adolescents :						
Incidental ingestion of COPCs			KP CB	KP CB		
Dermal contact with COPCs			KP CB	KP CB		
Subsistence Fisher Exposure Scenario:						
Ingestion of COPCs in fish						CB
Off-site Residential Exposure Scenario:						
Inhalation of airborne COPCs	UB	UB			UB	
Incidental ingestion of COPCs	UB	UB				
Dermal contact with COPCs	UB	UB				

[a]The data set used to estimate risk for each receptor is defined as indicated below:

- FMGP – Former Manufactured Gas Plant
- KP – Kreher Park
- UB – Upper Bluff
- SCB – Service Center Building
- CB – Chequamegon Bay

RISK CHARACTERIZATION RESULTS—REASONABLE MAXIMUM SCENARIO

In this section of the HHRA, toxicity and exposure assessments were integrated into quantitative and qualitative expressions of carcinogenic and noncarcinogenic risks. The detailed estimates of risks are presented numerically in **Attachment D** and are summarized in **Sections 5.1** and **5.2.**

Except for risks associated with the residential RME exposures to soil, industrial worker exposure to indoor air, and construction worker exposure to soil, carcinogenic and noncarcinogenic risks for all other media were within acceptable ranges of 10^{-4} to 10^{-6} and an HI of 1, respectively.

Summary of RME Carcinogenic and Noncarcinogenic Risksa

Receptor	Table	Soil		Sediment		Biota		Indoor Air[b]	
		CR	HI	CR	HI	CR	HI	CR	HI
Resident	20	**5×10^{-4}**	**15**	–	–	–	–		
Recreational Adult	21	3×10^{-6}	0.002	–	–	–	–	–	–
Recreational Adolescent	22	2×10^{-6}	0.003	–	–	–	–	–	–
Recreational Child	23	1×10^{-5}	0.04	–	–	–	–	–	–

Receptor	Table	Soil		Sediment		Biota		Indoor Air[b]	
		CR	HI	CR	HI	CR	HI	CR	HI
Adult Swimmer	24	–	–	5×10^{-9}	2×10^{-5}	–	–	–	–
Adolescent Swimmer	25	–	–	3×10^{-9}	2×10^{-5}	–	–	–	–
Adult Wader	26	–	–	1E-05	0.002	–	–	–	–
Adolescent Wader	27	–	–	5×10^{-6}	0.002	–	–	–	–
Industrial Worker	28 & 29	9×10^{-6}	0.007	–	–	–	–	8×10^{-5}	3
Maintenance Worker	30	1×10^{-6}	0.001	–	–	–	–	–	–
Construction Worker	31	**1×10^{-4}**	**35**	–	–	–	–	–	–
Subsistence Fisher	32	–	–	–	–	**1×10^{-4}**	0.01	–	–

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[a] *No COPCs were identified for soil gas and surface water. Risks based on exposure to these media were not quantified.*

[b] For the industrial worker, the air risks were estimated using indoor air data from sample locations NS-GSINDOOR-0405 and NS-GSINDOOR-0705.

RISK CHARACTERIZATION RESULTS—CENTRAL TENDENCY EVALUATION

Quantitative measures of uncertainty involve the calculation of central tendency evaluation (CTE) estimates. The CTE calculation involves the use of 50th percentile input parameters in carcinogenic and noncarcinogenic risk estimates as opposed to upper-bound values for parameters used in the RME calculations. The 50th percentile parameters are considered representative of the general receptor population. The CTE scenario was only calculated for pathways in which RME risks exceed the target risk goals (i.e., carcinogenic risks above 10^{-4} and an HI above 1).

The results of this evaluation is summarized below. Detailed CTE calculations are provided in **Attachment F, Tables 1** through **6** for residential receptors, **Tables 7** through **9** for construction workers, **Table 10** for the industrial worker and **Table 11** for the subsistence fisherman.

Receptor	Table	Soil	
		CR	HI
Resident (0-10 foot soil depth)	35	2×10^{-4}	8
Resident (0-3 foot soil depth)	36	5×10^{-5}	0.3
Construction Worker	37	3×10^{-5}	13
Industrial Worker (indoor air)	38	2×10^{-5}	1

CONCLUSIONS

The results of the HHRA indicate that only three exposure pathways result in estimated risks exceed USEPA's target risk levels: residential exposure pathways (for soil depths between 0 and 3 feet or all soil depths to 10 feet bgs), construction worker exposure pathway (for soil depths between 0 and 10 feet) and worker exposures to indoor air. These include estimates for the RME scenarios for potential cancer risks (a CR greater than 10^{-4}), and non-cancer risks (greater than an HI of 1). These conclusions are based on assumed exposures to soil in the filled ravine area (for residential receptors) and the filled ravine, upper bluff and Kreher Park area (for construction worker receptors), and to indoor air samples collected at NSPW Service Center. Carcinogenic risks based on CTE sceanrios indicate that only the residential receptor exposure to soil (all soil depths to 10 feet bgs) are estimated to be at 1×10^{-4}, the upper-end of the target risk range. Noncarcinogenic risks for the residential receptor (for all soil depths to 10 feet bgs) and risks associated with the construction scenario are within acceptable levels. However, residential receptor exposure to subsurface soil is not expected, given the current and potential future land use of the Site. For this Site, residential risks associated with exposures to surface soil (0 to 1 foot bgs) are within the target risk ranges.

Although the results of the HHRA indicate risks for the construction workers under the RME conditions exceed USEPA's target risk levels, the assumptions used to estimate risks to this receptor were conservative and assumed the worst case. Given both the current and future land use of the Site, it is unlikely that construction workers would be exposed to soil in the filled ravine and Upper Bluff. The most likely scenario for the future construction worker is exposure to soil within 0 to 4 feet bgs in Kreher Park (a typical depth for the installation of underground utility corridors), as most activities associated with the implementation of the future land use would be associated with regrading, landscaping, and road or parking lot construction. Therefore, risks to this receptor population are most likely overstated in this HHRA.

An HI of 3 was calculated for the worker exposure to indoor air pathway under the RME conditions. This risk level is likely to be an over-estimate because:

- It was estimated using the maximum detected concentrations as the concentrations at points of exposure.
- It was calculated based on the exposure parameters for the industrial /commercial workers (i.e., .an individual works at the Site for 8 hours per day, 5 days per week, 50 weeks per year for a total of 25 years). The NSPW Service Center is used as a warehouse; there is an office space inside the building, but used only on a part-time basis.

Risks to recreational users (surface soil), subsistence fishers (finfish), waders and swimmers (sediments), industrial workers (surface soil), and maintenance workers (surface soil) are all within USEPA's target risk range of 10^{-4} to 10^{-6} for lifetime cancer risk and a target HI of less than or equal to 1 for non-cancer risk.

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Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
ALM	Adult Lead Model
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
bgs	below ground surface
CDC	Centers for Disease Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm/sec	centimeters per second
COPC	Chemical of Potential Concern
CR	Cancer Risk
Csat	Chemical-specific Saturation Limit
CSM	Conceptual Site Model
CTE	Central Tendency Evaluation
DQO	Data Quality Objectives
EPC	Exposure Point Concentration
ft/ft	foot per foot
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IR	Intake Rate
IRIS	Integrated Risk Information System
IEUBK	Integrated Exposure Uptake Biokinetic Model
m^3/day	cubic meters per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MGP	Manufactured Gas Plant
MSL	mean sea level
MVUE	Minimum Variance Unbiased Estimate
NAPL	Non-aqueous Phase Liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NSPW	Northern States Power Wisconsin
ORNL	Oak Ridge National Laboratory

OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAH	Polycyclic Aromatic Hydrocarbon
PEF	Particulate Emission Factor
ppm	parts per million
PPRTV	Provisional Peer-reviewed Toxicity Value
PRG	Preliminary Remediation Goal
QAPP	Quality Assurance Project Plan
RAGS	Risk Assessment Guidance for Superfund
RAIS	Risk Assessment Information System
RBC	Risk-based Concentration
RBSC	Risk-based Screening Concentration
RfC	Reference Concentration
RfD	Reference Dose
RI/FS	Remedial Investigation and Feasibility Study
RME	Reasonable Maximum Exposure
RV	Recreational Vehicle
SF	Slope Factor
SQL	Sample Quantitation Limit
TIC	Tentatively Identified Compound
UCL	Upper Confidence Limit
U.S.C.	United States Code
USEPA	United States Environmental Protection Agency
VF	Volatilization Factor
VI	Vapor Intrusion
VOC	Volatile Organic Compound
WDHFS	Wisconsin Department of Health and Family Services
WDNR	Wisconsin Department of Natural Resources
WQS	Water Quality Standard
WWTP	Wastewater Treatment Plant
µg/L	micrograms per liter
µg/dL	micrograms per deciliter

Northern States Power Company, a Wisconsin corporation, d/b/a Xcel Energy (hereafter "NSPW"), submits this baseline Human Health Risk Assessment (HHRA) in accordance with the United States Environmental Protection Agency (USEPA) approved Remedial Investigation and Feasibility Study (RI/FS) Work Plan (URS, 2005), as amended (RI/FS Work Plan). This HHRA has been prepared to support the Ashland/NSP Lakefront Superfund Site (Site) RI/FS being conducted under the regulatory framework of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601, et seq. and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300.

1.1 PURPOSE

The purpose of the baseline HHRA is to provide a risk-based interpretation of the data collected during the RI and to provide conservative estimates of potential human health risks posed by chemicals that are present at or migrating from the Site. The results of the HHRA may also be used as the basis for risk management decisions. In summary, the objectives of the baseline HHRA are to:

- Quantify exposures and characterize baseline risks to potentially exposed individuals (both current and future) at or near the Site;
- Identify those chemicals that may pose risks to human health; and
- Provide the basis for risk management decisions.

1.2 APPROACH

This HHRA was completed using the data collected as part of RI/FS along with historical data from work previously completed by the Wisconsin Department of Natural Resources (WDNR) and the Wisconsin Department of Health and Family Services (WDHFS). The methodology for completing the HHRA follows guidance presented in *Risk Assessment Guidance for Superfund (RAGS): Volume I. Part A – Human Health Evaluation Manual* (USEPA, 1989) and several more recent regulatory guidance documents and resources as appropriate such as:

- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (OSWER 9355.4-24, March 2002)(USEPA, 2002a);
- *Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment* (EPA/540/R/99/005, OSWER 9285.7-02EP, PB99-963312, July 2004)(USEPA, 2004a);

- *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (OSWER 9285.6-10 December 2002)(USEPA, 2002b);

- *Exposure Factors Handbook* (EPA/600/P-95/002) August, 1997 (USEPA, 1997a); and

- A summary of up-to-date guidance and screening criteria presented in http://risk.lsd.ornl.gov/homepage/rap_docs.shtml, (Oak Ridge National Laboratory [ORNL], On-line).

A draft HHRA was submitted for review on April 7, 2006 as a stand alone report and on June 5, 2006 as part of the draft RI Report. The draft HHRA has been revised based on agency review comments provided on August 25, 2006 and October 27, 2006 and decisions agreed upon during the October 12, 2006 meeting between USEPA, WDNR, WDHFS and NSPW. This HHRA incorporates the following components:

- Section 2 Data Evaluation
- Section 3 Exposure Assessment
- Section 4 Toxicity Assessment
- Section 5 Risk Characterization
- Section 6 Uncertainty Analysis

1.3 SITE DESCRIPTION

The Site is located in S 33, T 48 N, R 4W in Ashland County, Wisconsin, shown on **Figure 1**. The Site consists of property owned by NSPW, a portion of Kreher Park, and sediments in an offshore area adjacent to Kreher Park. Existing site features showing the boundary of the Site are shown on **Figure 2**. The Site includes the following:

- NSPW's property (a former manufactured gas plant [MGP]), and potentially the areas beneath residences located on the upper bluff,

- Potentially the areas including a school, a playground, and a church (also located on the upper bluff);

- Soils along the flat terrace adjacent to the Chequamegon Bay shoreline including Kreher Park (filled lakebed areas north of the bluff face);

- Other areas of the filled former lakebed not within the Kreher Park boundary including a former City Wastewater Treatment Plant (WWTP) and buildings, grassed areas, and boat storage; and

- Impacted sediment in the lake adjacent to the filled lakebed area north of Kreher Park.

The NSPW property includes a small office building and parking lot fronting on Lake Shore Drive, and a larger vehicle maintenance building and parking lot area located south of St. Claire Street between Prentice Avenue and 3rd Avenue East. The office building and vehicle maintenance building are separated by an alley. A gravel-covered parking and storage yard area, with a large microwave tower, is located north of St. Claire Street between 3rd Avenue East and Prentice Avenue. A second gravel-covered storage yard area is located at the northeast corner of St. Claire Street and Prentice Avenue. The area occupied by the buildings and parking lots is relatively flat, at an elevation of approximately 640 feet above mean sea level (MSL). Surface water drainage from the NSPW property is to the north. Residences bound the Site east of the office building and the gravel-covered parking area near 3rd Avenue East. Our Lady of the Lake Church and School is located immediately west of NSPW's buildings. Private homes are located immediately east of Prentice Avenue. To the northwest, the Site slopes abruptly to the Canadian National (formerly Wisconsin Central Limited) Railroad property at a bluff that marks the former Lake Superior shoreline and then to the City of Ashland's Kreher Park, beyond which is Chequamegon Bay.

Based on current data, the impacted area of Kreher Park consists of a flat terrace adjacent to the Chequamegon Bay shoreline. The surface elevation of the park varies approximately 10 feet, from 601 feet MSL, to about 610 feet MSL at the base of the bluff overlooking the park. The bluff rises to an elevation of about 640 feet MSL, which corresponds to the approximate elevation of the NSPW property. The lake elevation generally fluctuates about two feet, from 601 to 603 feet MSL. At the present time, the park area is predominantly grass covered. A gravel overflow parking area for the marina occupies the west end of the Kreher Park property, while a miniature golf facility formerly occupied the east end of the Site. The former City of Ashland WWTP and associated structures front the bay inlet on the north side of the Kreher Park property. The impacted area of Kreher Park (excluding the affected sediments area) occupies approximately 13 acres and is bounded by Prentice Avenue and a jetty extension of Prentice Avenue to the east, the Canadian National railroad to the south, the Ellis Avenue and the marina extension of Ellis Avenue to the west and Chequamegon Bay to the north.

The offshore area with impacted sediments is located in an inlet created by the Prentice Avenue jetty and marina extensions previously described. For the most part, impacted sediments are confined in the inlet bounded by the northern edge of the line between the Prentice Avenue jetty and the marina extension. Data collected to date indicate that impacted sediment levels decline beyond this boundary. The affected sediments consist of lake bottom sand and silts, and are overlain by a layer of wood chips and larger wood waste fragments (slab wood, logs), likely originating from former lumbering operations. The wood waste layer varies in thickness from

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zero to seven feet, with an average thickness of nine inches. Based on current data, the entire area of impacted sediments encompasses approximately ten acres.

1.3.1 Population and Land Use

The Site is located in Ashland County, Wisconsin. Ashland County has a population of 16,866 and covers a land area of 1,047 square miles. The City of Ashland (population 8,620 based on the 2000 Census) is the largest city in Ashland County, as well as the county seat. The Bad River Indian Reservation, an area of 200 square miles, is located entirely within Ashland County and has a population of 1,538.

According to census estimates, the population of Ashland County and the City of Ashland have changed little since 1990. Ashland County grew by 3.3 percent between 1990 and 1999 (16,307 to 16,866). The City of Ashland dropped in population by 0.8 percent (8,695 to 8,620). This is consistent with the limited population growth in the region over the last 20 years.

Residents are served by the city's municipal water supply, which is provided from Chequamegon Bay surface water. The surface water intake is located at Longitude 90° 50' 29" E and Latitude 46° 36' 25"N. The intake is located in approximately 23 feet of water and is approximately one mile northeast of the Site. The area is located in the Lake Superior Lowland Physiographic Province characterized by flat to undulating topography underlain by red glacial clay (Miller Creek Formation). Uplands lie to the south of Ashland and are characterized by rolling hilly topography and underlain by sand and gravel soils (Copper Falls Formation). Elevations in the Ashland area range from 601 feet MSL datum (Lake Superior surface elevation) to approximately 700 feet MSL. Regional slope is generally to the north.

1.3.2 Geological and Hydrogeological Setting

The filled ravine at the upper bluff is a former drainage feature that begins near the NSPW administration building fronting on Lakeshore Drive, and deepens and widens to the north **(Figure 3)**. The mouth of the ravine opens to Kreher Park through the bluff face at the north end of the gravel storage yard. The maximum depth of fill in the ravine at the mouth is approximately 33 feet.

The Copper Falls Aquifer is a confined, variably coarse to fine-grained sand (reworked glacial till) that underlies the entire Lakefront site **(Figure 4)**. The formation is overlain by the surficial Miller Creek Formation, which is a lacustrine clay to silt till unit. At the NSPW property, the

Miller Creek Formation has a maximum thickness of about 35 feet; the thinnest portion of the unit is at the mouth of the former ravine, at approximately four feet.

Surficial soils at the Site are underlain by a variety of fill materials, including wood waste (slabs and sawdust), solid waste (including concrete, bricks, bottles, steel, wire, and cinders), and earthen fill (including a buried clay berm along the shoreline on the northeast side of the Site near the former WWTP). The fill materials at Kreher Park are underlain by a variably 0 to 5.5 foot thick layer of beach sand separating the fill from the underlying Miller Creek Formation. The Miller Creek soils encountered at the Site consist of clays and silts and range in thickness from 7 to 40 feet (the Miller Creek Formation thickens from the bluff face toward the shoreline and beyond to the north). Silty sand and gravel soils of the Copper Falls Formation are present beneath the Miller Creek soils. Thickness of the Copper Falls Formation at the site has not been determined, though monitoring wells installed in December 2003 suggest that the bedrock is at least 190 feet below ground level in at least some locations. The Copper Falls Formation consists of granular, cohesionless material deposited by glacial melt waters. Bedrock was encountered at 192 feet during the latest exploration drilling program at the NSPW property during December 2003 (monitoring well MW-2C). Bedrock in the Ashland area consists of Precambrian sandstones. To the south, beneath the NSPW facility, the Copper Falls consists of silty sands with discontinuous lenses of silty clay and silt. To the north, beneath Kreher Park, the Copper Falls formation consists of outwash sediments (i.e., clean sands with occasional gravel intervals).

Geology of the upper bluff area in the vicinity of the former ravine consists of earthen fill materials, with clay soils of the Miller Creek Formation on the flanks of the former ravine. The ravine fill unit consists of silty clay fill material mixed with ash, cinders, slag, and fragments of bricks, concrete, glass, wood, and other solid waste. The thickness of the fill diminishes to less than three feet beyond the flanks of the ravine to the east and west. Miller Creek clay soils are present at the base of the former ravine; however, the thickness of these soils has been measured at as little as four feet at one soil boring location (at the mouth of the ravine where it opened to the former lake shoreline). Sand and gravel layers interbedded with silty clay lenses have been encountered near the contact of the Miller Creek Formation and the underlying Copper Falls aquifer.

Offshore geology consists of a discontinuous layer of submerged wood chips on the lake bottom underlain by variably fine to medium grained sediments. The sediments are underlain by silts and clays of the Miller Creek Formation. The Copper Falls Formation was not encountered during earlier investigations of the offshore sediments. Consequently, the thickness of the Miller Creek Formation below the bay is unknown.

The water table is found within the fills overlying the Miller Creek Formation at the Site. (Where the Miller Creek is the surficial soil unit, the water table is also present within the Miller Creek Formation.) The hydraulic conductivity of the shallow soils and fill materials ranges from approximately 0.1 to 5 $\times$ 10^{-5} centimeters per second [cm/sec] (URS, 2005). The higher hydraulic conductivity values are typically found in locations with saturated wood waste fill. The horizontal hydraulic gradient is very flat (< 0.0004 foot per foot [ft/ft] to the north measured during June 2004) due to the high hydraulic conductivities on the Site.

Hydrogeology of the upper bluff area (the former MGP plant location of the Site) includes low permeability conditions (3 $\times$ 10^{-6} to 4 $\times$ 10^{-8} cm/sec) in the Miller Creek Formation comprising most of the shallow saturated soil in the area. Fill soils located in the former ravine area exhibit hydraulic conductivities approximately 1,000 times higher than the surrounding Miller Creek soils. The horizontal hydraulic gradient in the fill soils of the former ravine is approximately 0.09 ft/ft. Direction of the groundwater flow in the ravine fill is to the north (toward the mouth of the former ravine). An intermittent groundwater discharge to the surface used to be present at the base of the bluff in the proximity of the mouth of the former ravine in the form of a seep. This seep was found to be caused by a buried 12-inch clay tile pipe that traversed the length of the ravine at its base. The elevation of the seep was over five feet above the water table levels measured in MW-7, formerly located immediately adjacent to the seep. The buried pipe was located and the seep area capped as part of the 2002 interim action response (URS, 2002).

Artesian conditions are present at the Kreher Park areas of the Site in the Copper Falls aquifer. Hydraulic head levels of approximately 17 feet above ground surface have historically been measured in an artesian well located at Kreher Park. However, artesian conditions have not been identified in the Copper Falls aquifer in the vicinity of the former ravine area or the upper bluff area. An upward hydraulic gradient is present in the Copper Falls aquifer in the northern portion of the upper bluff area, and diminishes and eventually changes to a downward gradient south of the alley separating the NSPW Service Center Building from the Administration Building parking area. The general direction of flow in the Copper Falls aquifer is to the north (toward Chequamegon Bay). Hydraulic conductivity values for the Copper Falls aquifer ranging from 5.9 $\times$ 10^{-4} cm/sec to 9.6 $\times$ 10^{-4} cm/sec were derived from a 48-hour aquifer performance test at the NSPW property in 1997. These data were used to later design an interim coal tar removal system installed by NSPW during 2000 (URS, 2005).

1.3.3 Surface Water Features

The Site is located on the shore of Chequamegon Bay. Regional surface water drainage flows to the north through Fish Creek and several small unnamed creeks and swales into Chequamegon

Bay. Surface water at the Site flows either to the City of Ashland storm sewer system, or discharges directly to Chequamegon Bay. An open sewer is depicted on historic Sanborn Fire Insurance maps dating from 1901 to 1951 on the western portion of the Kreher Park area. The head of the sewer is shown at a location about two-thirds of the distance from the shoreline to the bluff face with no identified upstream inlet. It is not clear whether the open sewer was used for discharging stormwater, sanitary wastewater or both to Chequamegon Bay.

Surface water sampling was conducted by Short Elliot Hendrickson Inc. (SEH) in 1998. No chemicals were detected above ambient water quality criteria (AWQC) in twelve unfiltered surface water samples collected on January 14 and 15, 1998. However, in one unfiltered water column sample collected during a period on May 14, 1998, when wave heights were estimated to be between 60 and 90 cm[1], benzo(a)anthracene and benzo(a)pyrene exceeded secondary chronic and acute water quality criteria values, respectively. No VOCs exceeded AWQC in that sample. It is unknown whether the contaminants in this sample were adsorbed onto suspended particulates or in a dissolved state.

The polycyclic aromatic hydrocarbon (PAH) and volatile organic compound (VOC) impacted sediment is concentrated at the wood debris/sediment-water interface and concentrations generally decrease with depth, although exceptions are found in a few locations. The presence of impacted sediment and non-aqueous phase liquids (NAPLs) across the surface of the lakebed is consistent with the physical-chemical characteristics of the Site-related chemicals. The mode of chemical transport to sediments was likely through backfilling (i.e., construction activities associated with the former WWTP), historic surface water runoff, or possible discharge from one or more source areas (e.g., MGP plant, possible wood treatment residuals, coal tar dump, etc.).

Information provided by the City of Ashland's Department of Public Works indicates that the City had a combined storm and sanitary sewerage system until the early to mid-1980s. The storm sewer system was separated from the sanitary system at that time to reduce flow to the former WWTP. In the past, storm water discharged directly to Chequamegon Bay through three known outfalls within the Site. Those outfalls have been closed and stormwater is now re-routed to a discharge point east of the Site.

1.3.4 Groundwater Use

Groundwater is present in both a shallow aquifer and a confined deep aquifer. Currently the shallow groundwater is not used as a potable water source. There are two artesian wells in the

Site vicinity—one located near Prentice Avenue on the eastern boundary of the Site and the other located near the marina on the western boundary. Both wells draw water from the Copper Falls aquifer, which is a deep aquifer separated from the shallow groundwater by the Miller Creek Formation (URS, 2005; ATSDR, 2003). The City of Ashland temporarily closed these wells for public use in August 2004. The City of Ashland will determine when the wells will be reopened pending the outcome of the RI/FS. To date water from these wells have met all federal and state safe drinking water standards. Water from these artesian wells is considered safe to drink as Site-related chemicals have not been detected in these wells at levels of concern (ATSDR, 2003).

Except for the two artesian wells at Kreher Park, the Copper Falls aquifer is not used for drinking water and is not considered a source of human exposure. Shallow groundwater at the Site is not a drinking water source for the City of Ashland. Drinking water at the Site is provided by the City of Ashland that draws its water from intakes in Lake Superior, located approximately one mile northeast of the Site, which is outside the known extent of Site-related surface water impact. Therefore, there are no known receptors to shallow groundwater beneath the Site.

1.3.5 Current and Potential Future Land Use Patterns

The upland area (upper bluff/ravine area) is primarily used for industrial or commercial purposes.[2] Portions of the Site (e.g., the abandoned WWTP) are subject to trespassing activities. These areas, some of which are public streets, are readily accessible to the public although they are generally covered by clean fill or roadways.

The area near the lakefront is zoned conservancy district; i.e., acceptable for use as parkland. The filled lakebed portions of the Site are comprised of City parkland (Kreher Park). The area is readily accessible by the public and a majority of the Kreher Park area of the Site is mowed and maintained for public use. No physical barrier exists at the shoreline to prevent swimming or wading in the bay where the impacted sediments have been found, although warning signs are posted along the shore of the affected area. Kreher Park and the impacted sediments are surrounded by facilities that draw the public to the lakefront—a city marina, public swimming beach, a boat ramp and a recreational vehicle (RV) park and campground. Warning buoys also prohibit boats into the affected area.

[1] It is likely this estimate was based upon crest to trough height rather than wave height compared to lake surface.

[2] Although neighboring residences and the Our Lady of the Lake school and parish grounds are designated within the Site boundary, these areas have been characterized as affected by contaminated groundwater only.

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According to the Ashland Wisconsin Waterfront Development Plan, the City has future plans for expanding the RV park, located immediately adjacent to the Ashland Lakefront property to the east. The plan proposes that the swimming beach will be retained but the RV park will be relocated to the Clarkson Dock farther to the east. The plan proposes that the existing RV park land will be redeveloped into a parking lot and an interpretive center for the ore freighter and/or the Great Lakes Shipping and Mining Museum.

One of the first steps of the baseline HHRA process was to review data collected during site investigations to develop a data set to support the site-specific HHRA. The analytical data from the Site were reviewed to:

- Validate and organize sampling data that were of acceptable quality for their use in the detailed HHRA; and
- Identify a set of chemicals that are Site-related.

Data evaluation was conducted as follows.

2.1 DATA REVIEW PROTOCOL

RI analytical and field data were first compiled. Validated data were entered into the USEPA-specified database and tabulated for use. The data from previous sampling efforts and this RI were reviewed to:

- Identify the nature and extent of Site-related chemical; and
- Evaluate the usability, including any uncertainties associated with the data.

The data were checked against the data quality objectives (DQOs) identified in the approved Quality Assurance Project Plan (QAPP) (URS, 2005). Details of the procedures for assessing the precision, accuracy, representativeness, completeness and comparability of field data and analytical laboratory data are described in the QAPP. Qualifications to the data usability are discussed in the quality assurance section of any reports presenting the data. Data generated under this program were considered technically sound and of sufficient quality and quantity to support the needs of the data users.

Methods used to develop a data set to support the development of the HHRA are described in the following sections.

2.1.1 Tentatively Identified Compounds

Both the identity and reported concentrations of tentatively identified compounds (TICs) are highly uncertain. As outlined in the approved RI/FS Work Plan (URS, 2005), TICs were excluded from further evaluation in the baseline HHRA.

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2.1.2 Qualified Data

Qualifiers pertaining to uncertainty in the identity or the reported concentration of an analyte were assigned to certain analytical data by the laboratories or by persons performing data validation. The following qualifiers were used for HHRA data.

QUALIFIER	DEFINITION	USE OF QUALIFIED DATA IN HHRA
U	The analyte was analyzed for, but was not detected above the reported sample quantitation limit (SQL).	If the analyte is selected as a chemical of potential concern (COPC), then it is assumed to be present at one-half the SQL.
J	The analyte was positively identified; however, the associated numerical value is an estimate of the concentration of the analyte in the sample.	If the analyte is selected as a COPC, it is assumed to be present at the estimated concentration.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is an estimate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.	If the analyte is selected as a COPC, then it is assumed to be present at one-half the SQL.
R	The sample results are rejected and are, therefore, unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.	Data were excluded from the HHRA.

2.1.3 Duplicate Results

The highest measured concentrations of duplicate sample analytical results were used as the concentration term in the HHRA. If both duplicate samples are non-detect, then one-half of the lower reporting limit was adopted as the proxy sample point concentration for the purpose of calculating exposure point concentrations (EPCs).

2.1.4 Data Tabulation

To facilitate the data evaluation process, the analytical results were tabulated as follows:

- The analytical data were divided into groups by sample location identification numbers, sample collection dates, sampling zone, sampling areas, and environmental media of concern.

- Analytical results were reported in the text, tables and figures using a consistent and conventional unit of measurement such as microgram per liter (μg/L) for groundwater and surface water analyses, milligrams per kilogram (mg/kg) for soil and sediment analyses, and milligrams per cubic meter (mg/m^3) for air analyses.

Summary tables were prepared in accordance with the format recommended in RAGS, Part D (USEPA 2001a), to present relevant statistical data, such as the frequency of detection, the detection limits, the range of detected concentrations, the distribution of data and the source term concentrations to be used in the HHRA. However, RAGS Part D formatted tables provided by USEPA were not used to present this information.

2.2 ANALYTICAL DATA USED TO EVALUATE RISK

Although there has been a considerable amount of data collected at the Site, not all data collected were considered appropriate for evaluating human health risk. The sections below summarize the data selected for this HHRA.

2.2.1 Soil

Both surface and subsurface soil from several historical sampling events were evaluated in this HHRA. Data from sampling events completed between 1994 and 2005 were evaluated for inclusion in the HHRA. In general, all data from the previous investigations were used in the HHRA. However, a separate evaluation was performed by excluding chemical concentrations exceeding the soil saturation limit (Csat) in the derivation of concentration terms. This evaluation was prepared in response to review comments on the draft HHRA report. Information regarding this evaluation is presented in **Attachment H.**

Attachment H1	Calculation of Chemical-specific Csat Values
Attachment H2	Exposure Point Concentration Summary
Attachment H3	ProUCL Output Tables
Attachment H4	Risk Calculations

Surface soil is defined as soil from 0 to 1 foot below ground surface (bgs). Subsurface soil is defined as soil between 1 and 10 feet bgs. For this Site, 10 feet was selected as the limit to which construction activities may occur. Ten feet was selected based on the future recreational land use of the Site. It was assumed that 10 feet was the maximum depth at which utilities would be installed.

Tables 1 to **5** present the surface and subsurface soil sample locations used for this evaluation by receptor. These tables also define the source of each data point used in the evaluation. **Table 2-6** of the RI report identifies the analytical parameters completed for soil. **Tables 4-8A** and **4-8B** of the RI report provides a summary of the analytical results for surface and subsurface soil. **Figure 5** graphically presents the sample locations selected to evaluate human receptors at the Site.

2.2.2 Sediment

The sediment data used to evaluate human receptors was selected based on those areas in Chequamegon Bay that are associated with human activity and are at depths that are likely to be contacted. Waders are typically assumed to come in contact with surface sediments only when evaluating exposures associated with a wading scenario. For this HHRA, sediment data between 0 to 2 foot in depth and with 4 feet or less of surface water cover were used in response to review comments on the draft HHRA Report.

Presented below is a list of sediment locations evaluated in the HHRA.

2200N-1600E
2250N-1400E
2300N-3200E
2400N-1200E
2400N-2000E
2400N-2100E
2400N-2200E
2400N-2300E
NSP-SE-SS-12
NSP-SE-SS-13
NSP-SE-SS-14

These data were data selected based on a conservative assumption that waders may come in contact with sediments at depths when collecting wood. .

In addition, it was also assumed that sediment exposures could occur during surface water exposures. In this instance chemicals that are adsorbed on suspended sediment particles are assumed to be available for contact. However, there are no measured concentrations for this data set. Instead, a contact rate was developed based on the total suspended solids measurement of surface water using the equation below.

$$\text{Sediment Ingestion Rate}\left(\frac{\text{mg}}{\text{hour}}\right) = \text{Surface Water Ingestion Rate}\left(\frac{\text{mL}}{\text{hour}}\right) \times \text{Total Solids}\left(\frac{\text{mg}}{\text{mL}}\right)$$

Table 6 presents the sediment data used for this HHRA. **Table 2-6** of the RI report identifies the analytical parameters completed for sediment. **Table 4-9** of the RI report provides a summary of the analytical results for sediment. **Figure 5** outlines those locations that were selected to evaluate human receptors at the Site.

2.2.3 Surface Water

It was assumed that all surface water within Chequamegon Bay could be accessed during recreational activities; therefore, analytical data collected in 1998 and 2005 were evaluated for use in the HHRA. However, unfiltered grab samples collected within the Chequamegon Bay inlet were used to evaluate surface water exposures.

Table 7 identifies those sample data by sampling event that were used to evaluate exposure to surface water. **Table 2-6** of the RI report identifies the analytical parameters completed for surface water. **Table 4-11** of the RI report provides a summary of the analytical results for surface water. **Figure 5** shows those surface water locations that were selected to evaluate human receptors at the Site.

2.2.4 Air

2.2.4.1 Soil Vapor

Soil vapor samples were collected from soil vapor probes installed in the uppermost water-bearing unit in the vicinity of the former MGP facility. These samples were collected to provide data that were used to evaluate potential vapor migration and to ensure that soil vapors are not migrating off-site through subsurface soil towards adjacent private properties and into residential structures.

Table 8 presents the soil vapor data used for the HHRA. **Table 2-7** of the RI report identifies the analytical parameters completed for soil vapor. **Table 4-12** of the RI report provides a summary of the analytical results for soil vapor. **Figure 5** presents locations selected to evaluate human receptors at the Site.

2.2.4.2 Indoor Air Vapor Investigation

An indoor air sample was collected to evaluate the potential for vapor migration into the existing NSPW Service Center building, which overlies impacted soil in the backfilled ravine. The indoor air investigation was designed to evaluate the chemicals present in indoor air and sub-slab soil vapors to determine if this area is being impacted by soil vapor migration and intrusion.

Table 8 presents the indoor air data used for the HHRA. **Table 2-7** of the RI report identifies the analytical parameters completed for indoor air. **Figure 5** presents those locations selected to evaluate human receptors at the Site.

2.2.5 Biota

Several species of fin fish were collected at the Site. However, for the HHRA only the following three were assumed to be consumed on a consistent basis. These fin fish include:

- Shorthead Redhorse (*Moxostoma macrolepidotum*)
- Walleye (*Stizostedion vitreum*)
- Rainbow Smelt (*Osmerus mordax*)

Although samples were prepared and analyzed as either whole fish or fillets, only data associated with the edible portion were used in the HHRA. It was assumed that the sample as prepared for sampling corresponded to the edible portion of the fish. Fish were prepared as indicated below.

- Eight whole fish composite samples of smelt were collected from the Site and prepared as if for frying, i.e. their heads and entrails removed.
- Walleye were filleted (the skin was removed)
- Shorthead redhorse were processed as for smoking or pickling, i.e. only the head and entrails were removed.

Table 9 lists the fish samples used for this HHRA. **Table 2-6** of the RI report identifies the analytical parameters completed for fish tissue. **Figure 6** illustrates the locations selected to evaluate human receptors at the Site.

2.3 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

The procedures used for selecting COPCs evaluated in the baseline HHRA are summarized in the following sections.

2.3.1 Comparison with Background Concentrations

USEPA provides guidance indicating that an inorganic chemical can be excluded from further consideration in the HHRA if the detected concentrations are within the range of naturally occurring background levels (USEPA, 1989). Although background levels were identified in the RI/FS Work Plan as one of the screening criteria for identifying COPCs, no chemicals were

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excluded from the HHRA based on background comparison due to the lack of relevant medium-specific background levels.

2.3.2 Risk-Based Screening Approach

Although the presence of many chemicals may be identified in the environmental samples collected during site investigative activities, the results of a baseline HHRA are typically driven by a few chemicals and exposure pathways. To streamline the HHRA process and focus efforts on important issues, several methods have been developed by the regulatory agencies and the scientific community for the identification of chemicals and pathways that contribute significantly to the total risks posed by a site. A tiered, risk-based approach was used for the selection of COPCs to be further evaluated in the detailed HHRA for the Site. This approach is based on USEPA-developed methodology and follows standard HHRA procedures.

The maximum detected concentration of a chemical was compared with chemical- and medium-specific risk-based screening concentrations (RBSCs), defined as concentrations that are not expected to result in any adverse impact based on exposure conditions which served as the basis for the calculation. A chemical was selected as a COPC if its maximum detected concentration value exceeds the RBSC.

For purposes of this project, the preliminary remediation goals (PRGs) derived by the USEPA Region 9 (USEPA, 2004b) were adopted as the primary source of RBSCs because they are based on conservative assumptions of exposure scenarios. In addition, the use of these PRGs for screening purposes is considered to be common practice by USEPA Region 5.

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For those chemicals lacking an RBSC (i.e., PRG or risk-based concentration [RBC]) the standard practice of selecting surrogate chemicals based on similarities in structure was used to determine if a chemical should be included as a COPC. The surrogates used are identified in **Tables 10** to **18.**

It should also be noted that RBSCs that are protective of noncarcinogenic effects were adjusted by a factor of 0.1 (i.e., divided by a factor of 10) to account for possible additive effects of multiple chemicals. All RBSCs for the protection of carcinogenic effects are based on a target cancer risk of 1E-06.

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Sources of the RBSCs used for this project are presented below by media of concern.

	PRG				RBC	AWQC	VI
	Industrial Soil	**Residential Soil**	**Tap Water**	**Ambient Air**	**Fish Tissue**	**Surface Water Ingestion**	**Target Indoor Air Concentration**
Chemicals in Soil	✓	✓					
Chemicals in Indoor Air/Soil Gas							✓
Chemicals in Surface Water						✓	
Chemicals in Sediment		✓					
Chemicals in Fish Tissue					✓		

PRG – USEPA Region 9 Preliminary Remediation Goal (October 2004) (USEPA, 2004b)

RBC – USEPA Region 3 Risk-based Concentrations (October 2005) (USEPA, 2005a)

AWQC – USEPA National Recommended Water Quality Criteria (20026) for human health (water and organism) (USEPA, 2006a).

VI – Evaluating The Vapor Intrusion To Indoor Air Pathway From Groundwater and Soils (USEPA 2001b)

2.3.3 COPC Summary

The COPCs identified for this are primarily metals, SVOCs, and limited VOCs. A summary of the COPCs by receptor and medium is presented below. **Tables 10 to 19** present the detail screening summary tables by receptor and medium.

Chemical	Residential				Commercial/Industrial: General Industrial Worker		Commercial/Industrial: Maintenance Worker	Construction Worker	Recreational: Recreational User	Recreational: Swimmer Wader		Recreational: Fisherman
	SS & SB	SS	S:0-3	IA	SS	IA	SS	SS & SB	SS	SD	SW	Fish
Inorganics												
Antimony										x		
Arsenic	x	x	x		x		x	x	x			
Cadmium									x			
Iron										x		
Lead	x	x	x				x	x	x			
Manganese										x		
Thallium	x								x			
Vanadium										x		
SVOCs												
1-Methylnaphthalene	x		x					x		x		x
2-Methylnaphthalene	x							x		x		
Acenaphthene	x							x				
Benzo(a)anthracene	x		x				x	x	x	x		x
Benzo(a)pyrene	x	x	x		x		x	x	x	x		x
Benzo(e)pyrene												x
Benzo(b)fluoranthene	x		x				x	x	x	x		x
Benzo(k)fluoranthene	x		x					x	x	x		
Chrysene	x							x				
Dibenzo(a,h)anthracene	x		x					x				x
Dibenzofuran	x							x				x
Fluoranthene	x		x					x				
Fluorene	x							x				
Indeno(1,2,3-cd)pyrene	x		x				x	x	x	x		
Naphthalene	x		x					x		x		
Phenanthrene	x											
Pyrene	x		x					x				
VOCs												
1,2,4-Trichlorobenzene	x							x				
1,2,4-Trimethylbenzene	x		x			x		x				
1,3,5-Trimethylbenzene	x		x					x				
1,4-Dichlorobenzene						x						

					Commercial/Industrial				Recreational			
	Residential				General Industrial Worker		Maintenance Worker	Construction Worker	Recreational User	Swimmer Wader		Fisherman
Chemical	SS & SB	SS	S:0-3	IA	SS	IA	SS	SS & SB	SS	SD	SW	Fish
Benzene	x		x			x		x				
Ethylbenzene								x				
n-Butyl benzene								x				
sec-Butyl benzene								x				
Carbon tetrachloride						x						
Toluene								x				
Trichloroethylene						x						
Xylenes (total)	x							x				

Notes:
SS – surface soil
SB – subsurface soil
S:0-3 – soil (0 to 3 foot depth)
IA – indoor air
SD – sediment
SW – surface water

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Exposure assessment involves the identification of the potential human exposure pathways at the Site for present and potential future use scenarios. Present conditions are as they exist today and future conditions are based on potential future land uses of the Site. Potential release and transport mechanisms were identified for contaminated source media. Exposure pathways identified in the WDNR HHRA (SEH, 1998) were finalized by assessing additional information gathered during this RI.

The exposure pathway links the sources, types of environmental releases, and environmental fate with receptor locations and activity patterns. Generally, an exposure pathway is considered complete if it consists of the following four elements:

- A source and mechanism of release;
- A transport medium;
- An exposure point (i.e., point of potential contact with an impacted medium); and
- An exposure route (e.g., ingestion) at the exposure point.

All present and potential future use scenarios presented in the RI/FS Work Plan (URS, 2005) were evaluated. However, additional site-specific information gathered during the implementation of the work plan resulted in the deletion of some exposure scenarios for quantitative analysis. The rationale for exclusion of these exposure scenarios is discussed in Section 3.1.4.

3.1 HUMAN HEALTH CONCEPTUAL SITE MODEL

A conceptual site model (CSM) for the Site has been developed to identify the focus of the HHRA. A schematic presentation of the CSM is included as **Figure 7**. The CSM integrates historical information to preliminarily define source areas, release and transport processes, points of contact with affected media, complete and incomplete exposure routes, and potentially exposed populations for current and expected future Site uses. The CSM was refined based on Site-specific information gathered during the implementation of the work plan.

3.1.1 Known and Suspected Sources of Chemical Impacts and Release Mechanisms

Based on information with respect to the history of the Site and the results of previous investigations, the potential primary sources of impact are likely associated with past industrial operations; e.g., possible former wood treatment activities on the Site, past releases from the former MGP, releases of petroleum-based products from railcar off loading, releases from the construction and operation of the former WWTP, releases from filling activities at the Lakefront, or a combination of these possible sources. Surface and subsurface soil and groundwater that have been impacted may act as secondary sources of impact through mechanisms such as leaching of chemicals from soil, groundwater recharge to surface water and wind and mechanical erosion of chemicals in soil.

3.1.2 Retention or Transport Media

The medium directly impacted by past industrial activities is soil. Dust is considered a potential transport medium, because chemicals in soil may become entrained in fugitive dust. Surface runoff is considered a transport medium, because storm events may have generated episodic overland flow and carried chemicals away from disposal or spill areas.

3.1.3 Transport Pathway

Release mechanisms and transport pathways were evaluated for the Site. Listed below are potential cross-media transfer mechanisms of chemicals:

- Chemicals in subsurface soil may enter groundwater through infiltration/percolation;
- Chemicals in surface soil may be transported to surface water and sediments through surface runoff;
- Chemicals in groundwater may be transported to surface water and sediments through groundwater discharge;
- Chemicals in surface soil may be transported to the atmosphere via volatilization or fugitive dust emission;
- Chemicals in soil or groundwater may be transported to the atmosphere or indoor air through volatilization;
- Chemicals in surface water and sediments may be transported to fish tissue through bioconcentration; and
- Chemicals in sediments may be released to surface water when agitated.

3.1.4 Receptors and Exposure Scenario

Presented below is an overview of populations of potential concern selected for further evaluation in this HHRA. Potential receptors are discussed based on medium of interest (i.e., soil, groundwater, sediment, surface water, biota, and air). Updates to the receptor populations identified in the Final RI/FS Work Plan (URS, 2005) are discussed as necessary.

3.1.4.1 Exposure to COPCs in Soil

Residential Land Use Scenario: **Child and Adult Residents**

Upper Bluff - There is a residential area located upgradient from the Kreher Park area of the Site on the upper bluff area near the former ravine. Described below were three exposure scenarios assumed in this HHRA for the residential receptors:

- Exposure to surface (0-1 ft) and subsurface soil (1-10 feet bgs) This assumption was made because new construction would involve excavation of soil for the construction of basements. Therefore, subsurface soil would be brought to the surface resulting in a potential exposure pathway for residential receptors. This scenario represents the worst case for residential receptors, but is not likely to be the actual scenario associated with the Site.

- Exposure to surface soil The residential neighborhoods adjacent to the Site are established neighborhoods and are expected to remain in the future. According to the Ashland Wisconsin Waterfront Development Plan, the future use of the Kreher Park portion of the Site does not include a residential scenario. In an established residential setting and without intrusive activities, receptors would most likely be exposed to surface soil only.

- Exposure to soil in 0-3 ft bgs For informational purposes, COPCs in soil between 0 and 3 ft bgs were also considered for residential receptors based on the assumption that receptors could potentially be exposed to soil in 0-3 ft bgs when performing landscaping or gardening activities.

For the purpose of this HHRA, child and adult residents are assumed to be exposed to COPCs in soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Recreational Use Scenario: **Child, Adolescent and Adult Visitors**

Kreher Park is now comprised of City parkland. Child, adolescent and adult visitors are assumed to be exposed to COPCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

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Industrial/Commercial Land Use Scenario: Maintenance Workers

Although the Final RI/FS Work Plan (URS, 2005) indicated maintenance workers currently access the Site, additional information collected during the implementation of the RI/FS Work Plan indicates that City workers and utility maintenance personnel do not access the Site. However, the City may develop the existing marina and expand it into the affected area for recreational use. Therefore, a potential future maintenance worker was considered a receptor to surface soil at Kreher Park and the unpaved portions of the Upper Bluff area. It is conservatively assumed that maintenance workers may be exposed to COPCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Industrial/Commercial Land Use Scenario: General Industrial Workers

Except for the NSPW facility, no other industrial/commercial facilities exist within the Site. For this HHRA, general workers are defined as NSPW employees involved with non-intrusive, operational activities. Current and potential future general workers are not likely to be subject to significant exposure to environmental media in the normal course of their daily work. Although the potential for exposure to occur is expected to be low, general workers are assumed to be exposed to COPCs in surface soil via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways.

Industrial/Commercial Land Use Scenario: Construction Workers

Upper Bluff and Kreher Park - It is conservatively assumed that construction activities could take place at every area included in this evaluation and it is possible for construction workers to be exposed to COPCs detected in surface and subsurface soil samples collected from the Site via incidental ingestion, inhalation (of soil-borne vapor and particulates) and dermal contact pathways. For this HHRA subsurface soil is defined as a depth of 10 feet or less, which is a conservative estimate of the limit to which construction activities may occur based on the current and proposed future land use at the Site.

For informational purposes, a hot spot analysis was performed for construction worker using soil data collected from the Former Coal Tar Dump. The results of this analysis are presented in Section 6.6.

3.1.4.2 Exposure to COPCs in Indoor Air – Residents and Industrial Workers

Upper Bluff - There is a residential area located upgradient from the Kreher Park area of the Site on the upper bluff area, near the former ravine. For the purpose of this HHRA child and adult residents are assumed to be potentially exposed to COPCs volatilizing from soil and groundwater and entering the residences located near the ravine. In addition, potential exposures to COPCs in indoor air were also evaluated for industrial workers who may enter the NSPW service center/vehicle maintenance building periodically.

3.1.4.3 Exposure to COPCs in Groundwater

Trespassing Land Use Scenario: Trespassers

The RI/FS Work Plan indicated that groundwater in the seep area was a potential exposure point for trespassers. However, this exposure point has been eliminated because the seep area was capped as part of the 2002 interim action response (URS, 2002). Therefore, this exposure pathway is no longer complete and was not quantitatively evaluated in the HHRA.

Another potential point of exposure to groundwater is the former WWTP building where groundwater has infiltrated into the basement. The building is locked and the perimeter is fenced with warning signs posted. A quantitative evaluation for the potential trespasser exposures to the indoor air and water inside the former WWTP building was not performed due to the lack of data. No water samples were collected form the building. In 2002, a consultant for the City of Ashland inspected the inside of the WWTP building and collected a single round of indoor air samples to address potential inhalation exposure to City of Ashland workers. Samples were only analyzed for limited chemicals (selected PAHs, trimethylbenzene and acetic acid). The results of this sampling indicated that Site-related compounds are probably in the indoor air of the former WWTP building, and a thorough indoor air investigation was recommended before final re-use decisions (WDHFS, 2003)

Residential and Industrial/Commercial Land Use Scenarios

Groundwater is present in both a shallow aquifer and a confined deep aquifer. Currently the shallow groundwater is not used as a potable water source. There are two artesian wells in the Site vicinity—one located near Prentice Avenue on the eastern boundary of the Site and the other located near the marina on the western boundary. Both wells draw water from the Copper Falls aquifer, which is a deep aquifer separated from the shallow groundwater by the Miller Creek Formation (URS, 2005; ATSDR, 2003). The City of Ashland temporarily closed these wells for public use in August 2004. To date water from these wells have met all federal and state safe drinking water standards. Water from these artesian wells is considered safe to drink as Site-related chemicals have not been detected in these wells at levels of concern (ATSDR, 2003).

Except for the two artesian wells at Kreher Park, the Copper Falls aquifer is not used for drinking water and is not considered a source of human exposure. Shallow groundwater at the Site is not a drinking water source for the City of Ashland. Drinking water at the Site is provided by the City of Ashland that draws its water from intakes in Lake Superior, located approximately one mile northeast of the Site and is outside the known extent of surface water contamination. Therefore, there are no known receptors to shallow groundwater beneath the Site.

3.1.4.4 Exposure to COPCs in Surface Water and Sediments

Recreational Use Scenario: **Adolescent and Adult Visitors**

Kreher Park and Chequamegon Bay Sediments – The Site is surrounded by facilities that draw the public to the lakefront – a City marina, public swimming beach, a boat ramp and an RV park and campground. Adolescent and adult visitors are assumed to be exposed to COPCs in surface water and sediments via incidental ingestion and dermal contact pathways while swimming, wading, fishing, or boating. However, only risks associated with swimming and wading activities were quantified in the HHRA. This is because they represent activities that have the greatest contact with impacted media and are considered more conservative than exposures associated with fishing and boating.

3.1.4.5 Exposure to COPCs in Fish Tissue

Subsistence Fishing Scenario: **Adult Subsistence Fisher**

Impacted Sediment Areas – Adult subsistence fishers were selected as the fishing receptors because there are two Chippewa Bands (the Bad River Band and the Red Cliff Band of Lake Superior Chippewa) who may use Chequamegon Bay as their source of fish. For this HHRA it is conservatively assumed that adult subsistence fishers may be exposed to COPCs via ingestion of locally-caught fish. Although this scenario was selected based on the presence of the two Chippewa Bands, this exposure scenario and the selected exposure parameters are applicable to any subsistence fisher ingesting fish from Chequamegon Bay. **Attachment A** provides detailed information regarding the exposure parameters used and their sources.

Presented below is an overview of receptors of potential concern selected for further evaluation in this HHRA. Potential receptors are discussed based on medium of interest (i.e., soil, sediment, surface water, biota, and air). A detailed discussion of the risks associated with each receptor population is presented in **Section 5.1.**

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SUMMARY OF PATHWAYS EVALUATED IN HHRA						
Receptor Pathway	Media of Interest[a]					
	Surface Soil	Subsurface Soil	Sediment	Surface Water	Indoor Air	Biota
Industrial Worker Exposure Scenario:						
Inhalation of airborne COPCs	FMGP				SCB	
Incidental ingestion of COPCs	FMGP					
Dermal contact with COPCs	FMGP					
Construction Worker Exposure Scenario:						
Inhalation of airborne COPCs	KP FMGP	KP FMGP				
Incidental ingestion of COPCs	KP FMGP	KP FMGP				
Dermal contact with COPCs	KP FMGP	KP FMGP				
Maintenance Worker Exposure Scenario:						
Inhalation of airborne COPCs	KP UB	KP UB				
Incidental ingestion of COPCs	KP UB	KP UB				
Dermal contact with COPCs	KP UB	KP UB				
Recreational Exposure Scenario/Children:						
Inhalation of airborne COPCs	KP					
Incidental ingestion of COPCs	KP					
Dermal contact with COPCs	KP					
Recreational Exposure Scenario/Adolescents:						
Inhalation of airborne COPCs	KP					
Incidental ingestion of COPCs	KP					
Dermal contact with COPCs	KP					
Recreational Exposure Scenario/Adults:						
Inhalation of airborne COPCs	KP					
Incidental ingestion of COPCs	KP					
Dermal contact with COPCs	KP					
Recreational Exposure Scenario/Swimmer & Wader/Adults:						
Incidental ingestion of COPCs			KP CB	KP CB		
Dermal contact with COPCs			KP CB	KP CB		
Recreational Exposure Scenario/Swimmer & Wader/Adolescents :						
Incidental ingestion of COPCs			KP CB	KP CB		
Dermal contact with COPCs			KP CB	KP CB		
Subsistence Fisher Exposure Scenario:						
Ingestion of COPCs in fish						CB
Off-site Residential Exposure Scenario:						
Inhalation of airborne COPCs	UB	UB			UB	
Incidental ingestion of COPCs	UB	UB				
Dermal contact with COPCs	UB	UB				

[a]The data set used to estimate risk for each receptor is defined as indicated below:

- FMGP – Former Manufactured Gas Plant
- KP – Kreher Park
- UB – Upper Bluff
- SCB – Service Center Building
- CB – Chequamegon Bay

3.2 QUANTIFICATION OF CHEMICAL INTAKES

Integration of data gathered in the exposure assessment (i.e., the extent, frequency, and duration of exposure for the populations and pathways of concern) into a quantitative expression of chemical-specific intake is necessary to perform a quantitative risk characterization.

The potential for human receptors to be exposed to impacted media through relevant routes of exposure (e.g., inhalation, ingestion and dermal contact) were evaluated. Exposure pathways considered not applicable, based on site-specific information, were excluded from the quantitative evaluation in the baseline HHRA. Rationale for the elimination of exposure pathways is provided in respective sections.

Estimates of intake of COPCs are required for quantitative risk characterization. Described below is the basic equation used to calculate the human intake of COPCs (USEPA, 1989):

$$I = C \times \frac{IR \times EF \times ED}{BW \times AT}$$

Where:

I	=	Daily intake (mg of chemical per kg of body weight per day)
C	=	Concentration of COPC (e.g., mg/kg in soil or fish, mg/L in water or mg/m^3 in air)
IR	=	Intake rate; the amount of contaminated medium contacted over the exposure period (e.g., mg/day for soil and fish, L/day for water and m^3/day for air)
EF	=	Exposure frequency; describes how often exposure occurs (days/year).
ED	=	Exposure duration; describes how long exposure occurs (years).
BW	=	Body weight; the average body weight over the exposure period (kg)
AT	=	Averaging time; period over which exposure is averaged (days)

Each of the intake variables in the above equation consists of a range of values in the literature. To account for uncertainties associated with parameter values, two separate exposure scenarios were evaluated in this HHRA: a reasonable maximum exposure (RME) scenario and an average case (i.e., central tendency evaluation [CTE]). The RME represents the maximum exposure that is reasonably likely to occur while the CTE is representative of average exposure. The RME scenario was calculated using the 95% upper confidence limit of the arithmetic mean (95% UCLs) concentration and a combination of the mean and upper-bound exposure parameter values. The CTE scenario was calculated using the arithmetic mean concentration as the EPC and the mean exposure parameter values.

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General information regarding the formulae and parameter values for pathways evaluated in this HHRA is provided in **Attachment A, Tables 1 - 11** for both the RME and CTE scenarios.

3.3 DISTRIBUTION TESTING AND CALCULATION OF 95% UPPER CONFIDENCE LIMITS

The RI/FS Work Plan (URS, 2005) for the Site provided extensive detail outlining the methodology to be used to test the distribution of each data set and subsequent calculation of the 95% UCLs. For the HHRA, the USEPA guidance "Calculating the Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites" (USEPA, 2002b) and the accompanying ProUCL software (USEPA, 2004c) was used to estimate UCLs. Although the RI/FS Work Plan approach was in compliance with USEPA guidance, it did not indicate that USEPA software would be used to estimate UCLs for the Site, which is the preferred method for estimating 95% UCLs. **Attachment B1** provides summary tables which includes RME EPCs for each receptor data set evaluated. RME output from the ProUCL software (USEPA, 2004c) is presented in **Attachment B2**. A summary of the EPCs used for the CTE scenario are presented in **Attachments E**. A summary of the EPCs and associated ProUCL output tables for evaluations discussed in the Uncertainty Analysis (Section 6) is presented in **Attachments F1** and **F2**, respectively.

For this HHRA, distribution testing and UCL calculations were attempted when the sample population was greater than five and the percentage of nondetects was 15% or less. For data sets not meeting these criteria, the maximum detected concentration was selected as the EPC. For evaluating health impacts potentially associated with exposures to lead using either the Integrated Exposure Uptake Biokinetic Model (IEUBK) for Lead (USEPA, 1994; USEPA, 2005b) or the Adult Lead Model (ALM) (USEPA, 2003a), the average concentration of lead was used, in accordance with the USEPA guidance.

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The toxicity assessment provides a framework for characterizing the relationship between the magnitude of exposure to a chemical and the nature and likelihood of adverse health effects that may result from such exposure. In an HHRA, chemical toxicity is typically divided into two categories: carcinogenic and noncarcinogenic effects of concern. Potential health effects are evaluated separately for these two categories, because their toxicity criteria are based on different mechanistic assumptions and associated risks are expressed in different units. Provided in this subsection is an overview of the methodology used to develop a toxicity assessment as part of the HHRA for the Site.

4.1 SOURCES OF TOXICITY INFORMATION

Pertinent toxicological and dose-response information for chemicals were selected from the following sources, in accordance with USEPA guidance (USEPA, 2003b):

- Tier 1 – Integrated Risk Information System (IRIS), available on-line (USEPA, 2006)
- Tier 2 – USEPA's Provisional Peer-Reviewed Toxicity Values (PPRTVs)
- Tier 3 – Other toxicity values (e.g., California Environmental Protection Agency, the Agency for Toxic Substances and Disease Registry (ATSDR), and USEPA's Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b).

4.2 METHODOLOGY FOR EVALUATING CARCINOGENIC EFFECTS

For purposes of assessing risks associated with potential carcinogens, the USEPA has adopted the science policy position of "no-threshold;" i.e., there is essentially no level of exposure to a carcinogen which will not result in some finite possibility of tumor formation. This approach requires the development of dose-response curves correlating risks associated with given levels of exposure. Linear dose-risk response curves are generally assumed.

Carcinogenic risks associated with a given level of exposure to potential carcinogens are typically extrapolated based on slope factors (SFs) or unit risks. SFs are the upper 95 percent confidence limit of the slope of the dose-response curve, expressed in terms of risk per unit dose [given in $(mg/kg\text{-}day)^{-1}$]. Unit risks relate the risk of cancer development with the concentration of carcinogen in the given medium, expressed as either risk per unit concentration in air [given in $(\mu g/m^3)^{-1}$] or drinking water [given in $(\mu g/L)^{-1}$].

Current USEPA Superfund guidance for calculating a dermal SF is to adjust the oral SF with an oral absorption factor specific for that chemical. It should be noted that the oral absorption factor used in the calculation refers to absorption of the chemicals in the species upon which the SF is based; i.e., generally not absorption data in humans.

The equation for extrapolation of a default dermal SF is as follows:

$$\text{Default Dermal SF}\left[(\text{mg/kg-day})^{-1}\right] = \text{Oral SF}\left[(\text{mg/kg-day})^{-1}\right] \div \text{Oral Absorption Factor }(\%)$$

4.3 METHODOLOGY FOR EVALUATING NON-CARCINOGENIC EFFECTS

The USEPA has adopted the science policy position that protective mechanisms (such as repair, detoxification, and compensation) must be overcome before the adverse systemic health effect is manifested. Therefore, a range of exposures exists from zero to some finite value that can be tolerated by the organism without appreciable risk of expressing adverse effects.

The approach used by the USEPA to gauge the potential non-carcinogenic effects is to identify the upper boundary of the tolerance range (threshold) for each chemical and to derive an estimate of the exposure below which adverse health effects are not expected to occur. Such an estimate calculated for the oral route of exposure is an oral reference dose (RfD), and for the inhalation route of exposure is an inhalation reference concentration (RfC). The oral RfD is typically expressed as mg chemical per kg body weight per day, and the inhalation RfC is usually expressed in terms of concentration in the air (i.e., mg chemical per m^3 of air). However, for purposes of baseline HHRAs, inhalation RfC values can be converted to units of dose by multiplying by the inhalation rate (20 m^3/day, an upper-bound estimate for combined indoor-outdoor activity) and dividing by the body weight (70 kg, average body weight), as detailed in the following equation:

$$\text{Inhalation RfD (mg/kg-day)} = \left(\text{RfC (mg/m}^3) \times 20\, ^{\text{m}^3}\!/_{\text{day}}\right) \div 70\text{ kg}$$

Currently, two types of oral RfDs/inhalation RfCs are available from the USEPA, depending on the length of exposure being evaluated (chronic or subchronic). Chronic oral RfDs/inhalation RfCs are specifically developed to be protective for long-term exposure to a compound, and are generally used to evaluate the non-carcinogenic effects associated with exposure periods between seven years (approximately 10 percent of an average lifespan) and a lifetime. Subchronic oral RfDs/inhalation RfCs are useful for characterizing potential non-carcinogenic effects associated with shorter-term exposures. Current guideline for Superfund program risk assessment requires that subchronic oral RfDs/inhalation RfCs be used to evaluate the potential non-carcinogenic effects of exposure periods between two weeks and seven years.

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Toxicological criteria specifically derived for gauging potential human health concerns associated with the dermal route of exposure has not been developed by USEPA. For purposes of this HHRA, default dermal RfD values were extrapolated from oral RfDs (USEPA 1989), if:

- Health effects following exposure are not route-specific.
- Portal-of-entry effects (e.g., dermatitis associated with dermal exposure and respiratory effects associated with inhalation exposure) are not the principal effects of concern.

Exposures with the dermal route are generally calculated as absorbed doses, while oral RfDs are expressed as administered doses. Current USEPA Superfund guidance is to adjust the oral RfD with an oral absorption factor (i.e., percent chemical that is absorbed) to extrapolate a default dermal RfD, which is expressed in terms of absorbed dose. It should be noted that the oral absorption factor used in the calculation refers to absorption of the chemicals in the species upon which the RfD is based (i.e., generally not absorption data in humans).

The equation for extrapolation of a default dermal RfD is as follows:

$$\text{Default Dermal RfD}\,(\text{mg/kg - day}) = \text{Oral RfD}\,(\text{mg/kg - day}) \times \text{Oral Absorption Factor}\,(\%)$$

Toxicity values (both SFs and RfDs) used in this HHRA are provided in **Attachment A, Tables 12a** and **12b.**

4.4 TOXICOLOGICAL PROFILE FOR COPCS

Toxicological profiles are included for all selected COPCs. Toxicological profiles prepared by the ORNL and available through the online Risk Assessment Information System (RAIS) are presented in **Attachment C** on compact discs. For those chemicals for which an ORNL toxicological profile is unavailable on RAIS, an ATSDR toxicological profile was included. For chemicals without either an ORNL or an ATSDR toxicological profile, information from the National Library of Medicine's Hazardous Substance Data Bank is provided.

4.5 EVALUATING EXPOSURES TO LEAD

Because most human health effects data for lead are correlated with concentrations in the blood rather than an external dose, the traditional approach for evaluating health effects cannot be applied to lead. Lead is therefore evaluated separately from carcinogens and noncarcinogens.

USEPA has developed a model for predicting the effect of lead exposure on blood lead concentrations in children exposed to lead – the IEUBK model (IEUBK Windows v1.0 build

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261, [December 2005b]). The IEUBK Model is used to predict the risk of elevated blood lead levels in children (under age seven) that are exposed to environmental lead from many sources. The model estimates the risk that a typical child, exposed to specified media lead concentrations, will exceed a certain level of concern (10 micrograms per deciliter [µg/dL]) (USEPA, December 2005b). The target criterion for lead risk is 5% or less of child residents with an estimated blood lead level in excess of 10 µg/dL. The 10 µg/dL value is the "concern threshold" recommended by the U.S. Centers for Disease Control and Prevention (CDC) (ATSDR, July 1999).

The IEUBK model was run using site-specific lead concentrations in soil and default values for all other parameters (**Attachment A, Table 13**).

USEPA has also developed an ALM (version 05/19/2003) that can be applied to adult worker receptors. The ALM is currently the accepted and standard model to assess adult non-residential exposures to lead in soil and indoor dust. The model uses a simplified representation of lead biokinetics to predict quasi steady-state blood lead concentrations among adults who have relatively steady patterns of site exposures. The methodology focuses on estimating fetal blood lead concentrations in female workers. All the equations in the model are used to calculate target concentrations based on the probability of exceeding a blood lead level of 10 µg/dL for a fetus. Lead risks are considered unacceptable for a non-residential (worker) receptor if the fetal blood lead level for more than 5% of fetuses of adult female workers is estimated to equal or exceed the CDC concern threshold of 10 µg/dL. The ALM model was run using site-specific lead concentrations in soil and default values for all other parameter (**Attachment A, Table 14**).

The ALM is used to evaluate risks of lead exposure to the fetus of pregnant female industrial workers, construction workers, and other workers that are identified as relevant receptors at a site. Other worker standards or guidelines are cited for comparative purposes (ATSDR, July 1999). The Occupational Safety and Health Administration (OSHA) blood lead level of concern in adult workers (all occupations) is 30 µg/dL; the OSHA permissible standard is 40 µg/dL for all workers. OSHA established medical removal criteria for workers of 50 µg/dL, with reentry into the workplace allowed at 40 µg/dL. The American Conference of Governmental Industrial Hygienists (ACGIH) also established a blood lead level of concern of 30 µg/dL in workers.

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5.1 RISK CHARACTERIZATION

In this section of the HHRA, toxicity and exposure assessments were integrated into quantitative and qualitative expressions of carcinogenic and noncarcinogenic risks. The detailed estimates of risks are presented numerically in **Attachment D** and are summarized in **Sections 5.1** and **5.2**.

Carcinogenic risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. In accordance with guidance provided in RAGS, Part A (USEPA 1989), incremental risk of an individual developing cancer can be estimated by multiplying the calculated daily intakes, that are averaged over a lifetime of exposure, by the SFs. This carcinogenic risk estimate represents an upper-bound value since the SF is often an upper 95 % confidence limit of probability of response that is extrapolated from experimental animal data using a multistage model.

The potential for noncarcinogenic effects was evaluated by comparing an exposure level over a specified time period with an RfD derived for a similar exposure period. This ratio of exposure to toxicity is referred to as a hazard quotient (HQ). This HQ assumes there is a level of exposure below which it is unlikely even for sensitive populations to experience adverse health effects. If the HQ exceeds one, there may be concern for potential noncancer effects; however, this value should not be interpreted as a probability.

Carcinogenic and noncarcinogenic risk estimates were combined across pathways, as appropriate, to account for potential additive effects. The sum of HQs is termed a hazard index (HI). In general, USEPA recommends a target value or risk range (i.e., HI = 1 or cancer risk [CR] = 10^{-4} to 10^{-6}) as threshold values for potential human health impacts. When the HI exceeds unity, then the HQs will be segregated based on similarities in target organ effects. Information regarding target organs following exposures to COPCs was retrieved from the following sources:

- Risk Integrated System for Closure. Indiana Department of Environmental Quality.
- Tiered Approach to Corrective Action Objectives. Illinois Environmental Protection Agency.
- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.* March 2002. OSWER 9355.4-24 (USEPA, 2002a).

The risk characterization results presented in **Attachment D** for the RME scenario were compared to these target levels and are presented below for all media evaluated. These levels aid

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in determining the objectives of the baseline HHRA, which include determining whether additional response action is necessary at the Site. These levels provide a basis for determining residual chemical levels that are adequately protective of human health, provide a basis for comparing potential health impacts of various remedial alternatives, and help support selection of the no-action remedial alternative, where appropriate.

5.2 RISK CHARACTERIZATION RESULTS

Except for risks associated with the residential RME exposures to soil and construction workers exposure to soil, carcinogenic and noncarcinogenic risks for all other media were within acceptable ranges of 10^{-4} to 10^{-6} and 1, respectively. **Attachment D** provides a detailed presentation of the carcinogenic and noncarcinogenic risk calculations.

Summary of RME Carcinogenic and Noncarcinogenic Risksa

Receptor	Table	Soil		Sediment		Biota		Indoor Air[b]	
		CR	HI	CR	HI	CR	HI	CR	HI
Resident	20	**5×10^{-4}**	**15**	–	–	–	–		
Recreational Adult	21	3×10^{-6}	0.002	–	–	–	–	–	–
Recreational Adolescent	22	2×10^{-6}	0.003	–	–	–	–	–	–
Recreational Child	23	1×10^{-5}	0.04	–	–	–	–	–	–
Adult Swimmer	24	–	–	5×10^{-9}	2×10^{-5}	–	–	–	–
Adolescent Swimmer	25	–	–	3×10^{-9}	2×10^{-5}	–	–	–	–
Adult Wader	26	–	–	1E-05	0.002	–	–	–	–
Adolescent Wader	27	–	–	5×10^{-6}	0.002	–	–	–	–
Industrial Worker	28 & 29	6×10^{-6}	0.007	–	–	–	–	8×10^{-5}	3
Maintenance Worker	30	1×10^{-6}	0.001	–	–	–	–	–	–
Construction Worker	31	**1×10^{-4}**	**35**	–	–	–	–	–	–
Subsistence Fisher	32	–	–	–	–	**1×10^{-4}**	0.01	–	–

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[a] No COPCs were identified for soil gas and surface water. Risks based on exposure to these media were not quantified.

[b]For the industrial worker, the air risks were estimated using indoor air data from sample locations NS-GSINDOOR-0405 and NS-GSINDOOR-0705.

5.2.1 Risk Summary for the Residential Scenario

Risks associated with exposure to surface and subsurface soil for residents are a CR of 5×10^{-4} and an HI of 15 for samples collected within the filled ravine of former MGP. Both the cancer and noncancer risk exceed the USEPA target risk range of 10^{-4} to 10^{-6} for cancer and an HI of 1

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for noncancer endpoints, respectively. The resulting cancer risk of 5×10^{-4} is primarily attributed to benzo(a)pyrene (65%) and dibenzo(a,h)anthracene (10%). Upon review of the data gathered for benzo(a)pyrene, 10 sampling locations (located in both the filled ravine and the Upper Bluff) with detectable concentrations ranging from 22 to 340 mg/kg at intervals between 1 to 8 feet bgs are the main contributors to the benzo(a)pyrene cancer risk. In addition, one sample location for dibenzo(a,h)anthracene (CP110) with a reported concentration of 3.8 mg/kg (1 to 3 feet bgs) is the main contributor to the dibenzo(a,h)anthracene cancer risk.

The resulting HI of 15 is primarily attributed to naphthalene (with an HI of 11). Detailed calculations of cancer and noncancer risk are presented in **Attachment D, Tables 1** through **3**.

Based on the results of the IEUBK model inputting an average lead concentration of 90.5 mg/kg., the percentage of children predicted to have a blood lead concentration greater than 10 µg/dL is 0.11, which is within USEPA's target criteria of no more than 5% above the concern threshold of 10 µg/dL concentration. The results of the IEUBK are presented in **Attachment D, Table 3f.** While one location (GP-110 (1-3')) had a highly elevated lead concentration of 4000 mg/kg, only one other sample (GP-115 (1-3') had a concentration (480 mg/kg) that exceeded the screening level of 400 mg/kg. Thus, while there are elevated concentrations are in the loading dock area of the NSPW, the average concentration is below the screening level.

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5.2.1.1 Indoor Air Pathway

Measured concentrations in soil vapor samples collected from subsurface soil within the filled ravine area of the Site did not exceed the USEPA's risk target shallow soil vapor screening concentrations at a target risk level of 10^{-5} (**Table 17**) indicating that subsurface vapors are not migrating off-site towards the residential area at St. Claire Street and Prentice Avenue.

5.2.1.2 Residential Risk Discussion

PAHs appear to be the primary risk drivers for the residential receptor within the filled ravine area of the former MGP. The highest concentrations of PAHs, and thus the highest risks, are associated with PAHs detected at depths of 0 to 3 feet bgs. However, residents are not currently located in this area of the Site and residential areas are not likely to be established at this part of the Site in the future.

For this HHRA, it was conservatively assumed that the residential receptors would be exposed to both surface and subsurface soil. This assumption was made because new construction would involve excavation of soil for the construction of basements or foundations. Therefore, soil with

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high chemical concentrations would be brought to the surface resulting in a potential exposure pathway for residential receptors. This scenario represents the worst case for residential receptors, but is not likely to be the actual scenario associated with the Site. The residential neighborhoods adjacent to the Site are established neighborhoods and are expected to remain in the future. According to the Ashland Wisconsin Waterfront Development Plan, the future use of the Kreher Park portion of the Site does not include a residential scenario. Therefore, residential receptors would only be exposed to surface soil. If it is assumed that residential receptors adjacent to the Site tend gardens, then it is possible that the first three feet of soil will represent the most likely exposure point.

Re-evaluating the residential receptor using EPCs derived based on the exposure to surface soil and soil to a depth of 3 feet indicates that carcinogenic and noncarcinogenic risks within USEPA's target risk range of 10^{-4} to 10^{-6} for cancer endpoints and an HI of 1 for noncancer endpoints.

Receptor	Table	Soil	
		CR	HI
Resident (Surface Soil only)	33	1×10^{-5}	0.2
Residential (0-3 feet bgs)	34	3×10^{-4}	0.9

The resulting CR of 1×10^{-5} for exposure to surface soil only is primarily attributed to arsenic (76 percent). Upon review of the data, one sampling location (ISS19) with a reported concentration of 8.5 mg/kg is the main contributor to arsenic cancer risk. **Attachment F1, Tables 1** through **5,** in **Appendix H** provides a detailed presentation of these calculations.

Seventy eight percent of the resulting CR of 3×10^{-4} (exposure to soil between 0 and 3 feet bgs) is attributed to benzo(a)pyrene. Upon review of the data, 12 sampling locations within the filled ravine area with reported concentrations ranging from 0.19 to 220 mg/kg (at depths greater than 1 foot bgs) are the main contributors to cancer risk. **Attachment F2, Tables 6** through **10** in **Appendix H** provide a detailed presentation of these calculations.

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5.2.2 Risk Summary for the Recreational Scenario

The following pathways were considered for the recreational scenarios:

- Recreational adults, adolescent, and children exposed to surface soil
- Recreational adult, adolescent, and child swimmers exposed to surface water

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- Recreational adult, adolescent, and child waders exposed to sediment and surface water

No COPCs were selected for the surface water pathway; therefore, cancer and noncancer risks were not calculated for this medium. In general, risks associated with exposure to surface soil and sediment by recreational users were estimated to be between 1×10^{-5} and 1×10^{-6}. Risks associated with each medium and recreational receptor are discussed below.

Comment [TB1]: What about dermal contact with sheens??

5.2.2.1 Risk Summary for Recreational Users Exposed to Surface Soil

Only limited metals and carcinogenic PAHs were identified as COPCs for recreational user exposure to surface soil. Cancer and noncancer risks to recreational adults and adolescents exposed to surface soil are generally a CR between 1×10^{-6} and 1×10^{-4} and less than an HI of 1. Cancer risks to a recreational child exposed to surface soil are 1×10^{-4}, but less than a noncancer risk of an HI of 1. The primary risk driver for the recreational adult, adolescent and child is benzo(a)pyrene.

A summary of the risks to the recreational adult, adolescent, and child are provided in Tables **21**, **22**, and **23**. A detailed presentation of the risk calculations for the recreational adult, adolescent, and child are provided in **Attachment D**, **Tables 4** to **12**.

Recreational Adults

Risks associated with exposure to surface soil for recreational adults are a CR of 3×10^{-6} and an HI of 0.002 for samples collected within Kreher Park. Both the cancer and noncancer risks are within the USEPA target risk range of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints, respectively. Approximately 76 percent of the resulting CR of 3×10^{-6} is attributed to benzo(a)pyrene. Upon review of the data gathered for benzo(a)pyrene for the Site, four sampling locations (located in Kreher Park, one of which is located within the Former Coal Tar Dump, sample TP-118) with detectable concentrations ranging from 7.4 to 68 mg/kg at intervals between 0 to 1 foot bgs are the main contributors to the benzo(a)pyrene cancer risk.

Detailed calculations of the risks to recreational adults is presented in **Attachment D**, **Tables 4** to **6**.

Recreational Adolescents

Risks associated with exposure to surface soil for recreational adolescents are a CR of 2×10^{-6} and an HI of 0.003 for samples collected within Kreher Park. Both the cancer and noncancer risk are within the USEPA target CR of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints, respectively.

Approximately 76 percent of the resulting cancer risk is attributable to benzo(a)pyrene. Upon review of the data gathered for benzo(a)pyrene for the Site, four sampling locations (located in Kreher Park, one of which is located within the Former Coal Tar Dump, sample TP-118) with detectable concentrations ranging from 7.4 to 68 mg/kg at intervals between 0 to 1 foot bgs are the main contributors to the benzo(a)pyrene cancer risk.

Detailed calculations of the risks to recreational adolescents is presented in **Attachment D, Tables** 7 to **9**.

Recreational Children

Risks associated with exposure to surface soil for recreational children are a CR of 1×10^{-5} and an HI of 0.04 for samples collected within Kreher Park. Both the cancer and noncancer risks are within the USEPA target CR range of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints, respectively. Approximately 74 percent of the resulting cancer risk is attributed to benzo(a)pyrene. Upon review of the data gathered for benzo(a)pyrene for the Site, four sampling locations (located in Kreher Park, one of which is located within the Former Coal Tar Dump, sample TP-118) with detectable concentrations ranging from 7.4 to 68 mg/kg at intervals between 0 to 1 foot bgs are the main contributors to the benzo(a)pyrene cancer risk.

Detailed calculations of the risks to recreational children is presented in **Attachment D, Tables 10** to **12**.

5.2.2.2 Risk Summary for Recreational Swimmers Exposed to Sediment and Surface Water

Because no COPCs were identified for surface water, calculation of risk was not required for the recreational swimmers.

Adult Swimmers Exposed to Sediment

Risks associated with exposure to sediment for adult swimmers are a CR of 5×10^{-9} and an HI of 0.00002 for samples collected within Chequamegon Bay. Both the cancer and noncancer risk are below the USEPA target risk range of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints, respectively.

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Detailed calculations of the risks to adult swimmers is presented in **Attachment D**, **Tables 13** and **14**.

Adolescent Swimmers Exposed to Sediment

Risks associated with exposure to sediment for adolescent swimmers are a CR of 3×10^{-9} and an HI of 0.00002 for samples collected within Chequamegon Bay. Both the cancer and noncancer risk are below the USEPA target risk range of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints, respectively.

Detailed calculations of the risks to adolescent swimmers are presented in **Attachment D**, **Tables 15** and **16**.

5.2.2.3 Risk Summary for Recreational Waders Exposed to Sediment and Surface Water

Because no COPCs were identified for surface water, calculation of risk was not required for the recreational waders.

Adult Waders Exposed to Sediment

Risks associated with exposure to sediment for adult waders are a CR of 1×10^{-5} and an HI of 0.002 for samples collected within Chequamegon Bay. The cancer risk is within the USEPA target risk range of 10^{-4} to 10^{-6} for cancer and noncancer risk is less than the target HI of 1 for noncancer endpoints.

Approximately 82 percent of the resulting cancer risk is attributable to benzo(a)pyrene. Upon review of the data gathered for benzo(a)pyrene for the site, three sampling locations (220N-1600E, 2250N-1400E, 2400N-1200E) with detectable concentrations ranging from 10.5 to 26 mg/kg at intervals between 0 to 2 feet bgs are the main contributors to the benzo(a)pyrene cancer risk.

Detailed calculations of the risks to adult waders is presented in **Attachment D**, **Tables 17** and **18**.

Adolescent Waders Exposed to Sediment

Risks associated with exposure to sediment for adolescent waders are a CR of 5×10^{-6} and an HI of 0.002 for samples collected within Chequamegon Bay. The cancer risk is within the USEPA target risk range of 10^{-4} to 10^{-6} for cancer and an HI of 1 for noncancer endpoints.

Approximately 82 percent of the resulting cancer risk is attributable to benzo(a)pyrene. Upon review of the data gathered for benzo(a)pyrene for the Site, three sampling locations (220N-1600E, 2250N-1400E, 2400N-1200E) with detectable concentrations ranging from 10.5 to 26 mg/kg at intervals between 0 to 2 feet bgs are the main contributors to the benzo(a)pyrene cancer risk.

Detailed calculations of the risks to adolescent waders is presented in **Attachment D**, **Tables 19** and **20**.

5.2.3 Risk Summary for the Construction Scenario

PAHs appear to be the primary cancer risk drivers for the construction scenario within the Kreher Park area of the Site. Of the calculated CR of 1 x 10^{-4}, approximately 71 percent is attributable to benzo(a)pyrene and 11 percent is attributable to dibenzo(a,h)anthracene. Upon review of the data, 27 sampling locations (located in both the filled ravine and Kreher Park) with detectable concentrations ranging from 205 to 3,000 mg/kg at intervals between 1 to 8 feet bgs are the main contributors to the benzo(a)pyrene cancer risk. In addition, 24 sample locations for dibenzo(a,h)anthracene (located in Kreher Park) with an detectable concentrations ranging from 28 to 250 mg/kg (2 to 8 feet bgs) are the main contributors to the dibenzo(a,h)anthracene cancer risk. Detailed calculations of the construction scenario cancer risks are provided in **Attachment D**, **Tables 21** to **23**.

The resulting HI of 35 is primarily attributed to naphthalene (with an HI of 31 and 2-methylnaphthalene (with a HI of 1). Because the HI exceeds 1, the noncancer risk for this receptor was re-calculated based on target organs affected by each chemical. **Table 31** shows that target organ-specific HI is greater than 1 for respiratory and systemic target organ effects. Detailed calculation of the construction scenario noncancer risks are provided in **Attachment D**, **Tables 21** to **23**.

Based on the results of the ALM inputting an average lead concentration of 88.7 mg/kg, the percentage of developing fetuses predicted to have a blood lead concentration greater than 10 µg/dL is 1.5, which is within USEPA's target criteria of no more than 5% of fetuses of adult female workers above the concern threshold of 10 µg/dL. The results of the ALM are presented in **Attachment D**, **Table 3f**. While one location (GP-110 (1-3')) had a highly elevated lead concentration of 4000 mg/kg, only one other sample (GP-115 (1-3')) had a concentration (480 mg/kg) that exceeded the screening level of 400 mg/kg. Thus, while there are elevated concentrations are in the loading dock area of the NSPW, the average concentration is below the screening level.

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For this HHRA, it was assumed that the construction receptors would be exposed to both surface and subsurface soil. This assumption was made based on the definition of the construction scenario (USEPA, 2002a), which would involve the construction of residential or commercial structures at the Site. This represents the worst case scenario and is not likely to occur at the Site given both its current and future land use. Kreher Park is an established park and is expected to remain in the future. Any expansion to the recreational areas of the Site would likely be associated with activities such as the installation of landscaping, sidewalks, and parking lots all of which do not involve excavation to significant depths (USEPA, 2002a). Therefore, construction receptors would most likely be exposed to shallow soils.

A hot spot analysis was performed for the construction scenario using data collected from the following locations near the Former Coal Tar Dump. The results of this analysis are presented in **Section 6.6.**

Location	Sample ID	Depths
TP-4	1040	4-6
TP-4	933	4-6
TP112	NS-GWTP112-0605	4.5-5
TP112	NS-SOTP112-0-1-061405	0-1
TP112	NS-SOTP112-5	4.5-5
TP112	NS-SOTP112-5-AD	4.5-5
TP113	NS-SOTP113-0-1-061405	0-1
TP113	NS-SOTP113-4	3.5-4
TP115	NS-SOTP115-0-1-061305	0-1
TP115	NS-SOTP115-4	3.5-4
TP115	NS-SOTP115-4-AD	3.5-4
TP116	NS-SOTP116-0-1-061305	0-1
TP116	NS-SOTP116-3	2.5-3
TP118	NS-GWTP118-0605	3.5-4
TP118	NS-SOTP118-0-1-061305	0-1
TP118	NS-SOTP118-3	3.5-4
TP119	NS-SOTP119-0-1-061305	0-1
TP119	NS-SOTP119-5	4.5-5

5.2.4 Risk Summary for the General Industrial Worker

For the industrial worker, samples collected within a 0-2 foot depth interval should be included in the 0-1 ft dataset, as the average sample depth was 1 foot (i.e., , GP-137, GP-131, GP-120). An conservative evaluation of the risks was performed using the average concentration of benzo(a)pyrene at these locations as the EPC since the concentrations of these samples were greater than maximum detected concentration within the industrial worker dataset. Risks from ingestion and dermal contact exposure were calculated. . Cancer and noncancer risks associated

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with the exposure to surface soil for the general industrial worker receptor are a CR of 6×10^{-6} and an HI of 0.007. Cancer and noncancer risks associated with exposure to indoor air are a CR of 8×10^{-5} and an HI of 3, respectively. The primary cancer risk drivers are trichloroethylene (44 percent) and benzene (3 percent). The resulting HI of 3 is primarily attributed to 1,2,4 trimethylbenzene with an HI of 2.

The results of these evaluations are summarized in **Tables 28** and **29**. Detailed calculations for this receptor are provided in **Attachment D, Tables 24 - 27.**

5.2.5 Risk Summary for the Maintenance Worker

Cancer and noncancer risks associated with the exposure to surface soil for the maintenance worker receptor are a CR of 1×10^{-6} and an HI of 0.001. Risks for this receptor are within the target risk levels. The results of this evaluation are summarized in **Attachment D, Tables 28 – 30.**

Based on the results of the ALM, the percentage of developing fetuses predicted to have a blood lead concentration greater than 10 µg/dL is 1.6, which is within USEPA's target criteria of no more than 5% of fetuses of adult female workers above the concern threshold of 10 µg/dL. A detailed presentation of the ALM for the maintenance worker is provided in **Attachment D, Table 30f.**

5.2.6 Risk Summary for the Subsistence Fisherman

Risks associated with the ingestion of locally-caught fish from Chequamegon Bay is a CR of 1×10^{-4}, which is just within the USEPA target cancer risk range of 10^{-4} to 10^{-6} for cancer endpoints. Although the primary risk drivers for this scenario are the carcinogenic PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[e]pyrene, dibenzo[a,h]anthracene, and indeno[1,2,3-cd]pyrene), individual cancer risks for each detected carcinogenic PAH is between 1×10^{-5} and 1×10^{-6}. The results of this evaluation are summarized in **Table 32**. Detailed calculations for this receptor are provided in **Attachment D, Tables 31a** and **31b.**

5.3 CENTRAL TENDENCY EVALUATION

Quantitative measures of uncertainty involve the calculation of CTE risk estimates. The CTE calculation involves the use of 50th percentile input parameters in carcinogenic and noncarcinogenic risk estimates as opposed to upper-bound values for parameters used in the

RME calculations. The 50th percentile parameters are considered representative of the general receptor population. The chemicals driving the RME risk were evaluated using these average exposure assumptions and the arithmetic mean concentration to derive risk for the CTE scenario rather than the upper-bound and 95% UCL concentrations used for the RME scenario. The CTE scenario was only calculated for pathways in which RME risks exceed the target risk goals (i.e., carcinogenic risks above 10^{-4} and an HI above 1); this includes only the residential and construction worker pathways. The results of this evaluation is summarized below and presented in **Tables 35**, **36**, and **37**. Detailed CTE calculations are provided in **Attachment F, Tables 1 – 6** for residential receptors, **Tables 7 – 9** for construction workers, **Table 10** for the industrial worker and **Table 11** for the subsistence fisherman.

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Receptor	Table	Soil	
		CR	HI
Resident (0-10 foot soil depth)	35	2×10^{-4}	8
Resident (0-3 foot soil depth)	36	5×10^{-5}	0.3
Construction Worker	37	3×10^{-5}	13
Industrial Worker (indoor air)	38	2×10^{-5}	1
Subsistence Fisherman	39	3×10^{-6}	0.0003

5.3.1 *Residents (0-10 foot soil depth)*

Approximately 70 percent of the resulting CR of 1×10^{-4} for residents exposed to soil between 0 and 10 feet is attributable to benzo(a)pyrene. Upon review of the data , 12 sampling locations (located in both the filled ravine and the Upper Bluff) with detectable concentrations ranging from 16 to 340 mg/kg at intervals between 1 to 8 feet bgs are the main contributors to the benzo(a)pyrene cancer risk. The resulting HI of 5 is primarily attributed to naphthalene (with an HI of 3).

5.3.2 Residents (0-3 foot soil depth)

The resulting cancer risk of 5×10^{-5} for residents exposed to 0 to 3 feet of soils is primarily attributed to benzo(a)pyrene (seventy one percent). Upon review of the data, three sampling locations (GP110, GP-113, and GP-115) with detectable concentrations ranging from 7.8 to 220 mg/kg at intervals between 1 to 3 feet bgs are the main contributors to the benzo(a)pyrene cancer risk. The resulting HI of 0.3 is below the target criterion for the HI of 1.

5.3.2 Construction Worker

The resulting CR of 2×10^{-5} is primarily attributed to benzo(a)pyrene and dibenz(a,h)anthracene. Approximately 82 percent of the resulting cancer risk is attributable to benzo(a)pyrene (71%) and to dibenzo(a,h)anthracene (11%). . Upon review of the data , 30 sampling locations (located in the filled ravine, the Upper Bluff, and Kreher Park) with detectable concentrations ranging from 130 to 3,000 mg/kg at intervals between 1 to 8 feet bgs are the main contributors to the benzo(a)pyrene cancer risk. In addition, 23 sample locations for dibenzo(a,h)anthracene (located in Kreher Park) with an detectable concentrations ranging from of 28 to 250 mg/kg (2 to 8 feet bgs) are the main contributors to the dibenzo(a,h)anthracene cancer risk.

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The resulting HI of 9 is primarily attributed to naphthalene with an HI of 8.

5.3.3 Industrial Worker

Cancer and noncancer risks associated with exposure to indoor air for industrial workers are a CR of 2×10^{-5} and an HI of 1, respectively. Both the cancer and noncancer risks are within USEPA target levels of 10^{-4} to 10^{-6} for cancer risk and an HI of 1.

Attachment F2, Table 10a and **10b** provide detailed calculations for cancer and noncancer risks. **Table 38** summarizes the CTE for this receptor.

5.3.4 Subsistence Fisherman

Cancer and noncancer risks associated with ingestion of locally-caught fish by a subsistence fisher are a CR of 3×10^{-6} and an HI of 0.0003, respectively. Both the cancer and noncancer risks are within USEPA's target risk levels of 10^{-4} to 10^{-6} for cancer risk and an HI of 1. The primary risks driver is benzo(a)pyrene with a cancer risk of 2×10^{-6}.

Attachment F2, Tables 11a and **11b** provide detailed calculations for cancer and noncancer risks. **Table 39** summarizes the risks estimated for this receptor.

6.1 OVERVIEW

In any HHRA, estimates of potential carcinogenic risk and noncarcinogenic health effects have numerous associated uncertainties. The primary areas of uncertainty and limitations are qualitatively discussed. Areas of uncertainty that are discussed in the RI report include, but are not limited, the following:

- Data collection and evaluation;
- Assumptions regarding exposure scenarios;
- Applicability and assumptions of models selected to predict the fate and transport of COPCs in the environment; and
- Parameter values for estimating intake of COPCs.

Each type of uncertainty is discussed in the sections that follow.

6.2 DATA COLLECTION AND EVALUATION

6.2.1 Residential Scenario Evaluation

For this risk assessment it was assumed that the residential receptors would be exposed to both surface and subsurface soil. This assumption was made because new construction would involve excavation of soil for the construction of basements. Therefore, soil with high chemical concentrations would be brought to the surface resulting in a potential exposure pathway for residential receptors. This scenario represents the worst case for residential receptors, but is not likely to be the actual scenario associated with the Site. The residential neighborhoods adjacent to the Site are established neighborhoods and are expected to remain so in the future. According to the Ashland Wisconsin Waterfront Development Plan, the future use of the Kreher Park portion of the Site does not include a residential scenario. Therefore, residential receptors would only be exposed to surface soil. If it is assumed that residential receptors adjacent to the Site tend gardens, then it is possible that the first three feet of soil will represent the most likely exposure point.

Re-evaluating the residential receptor using exposure point concentrations derived based on the exposure to surface soil or soil to a depth to three feet indicates that carcinogenic and noncarcinogenic risks are as presented below.

Receptor	Table	RME		CTE	
		CR	HI	CR	HI
Resident (0 – 10 feet soil depth)	20	5×10^{-4}	15	2×10^{-4}	8
Resident (0-1 foot soil depth)	33	1×10^{-5}	0.2	1×10^{-5}	0.2
Resident (0 – 3 foot soil depth)	34	3×10^{-4}	0.9	–	–

An examination of the analytical data used to derive the carcinogenic and noncarcinogenic risks to residents exposed to surface and subsurface soil to a depth of 3 feet shows that the risks are highest in samples collected between 1 and 3 feet bgs for the samples collected in the courtyard area of the former MGP. Locations GP110 and GP115 had the highest detections of all chemicals identified as COPCs at the 1 to 3 foot depth. An examination of the risks associated with sample location SS-24, which is located between the residence on Lakeshore Drive and the former MGP, shows that both carcinogenic and noncarcinogenic risks are 7×10^{-6} and 0.1, respectively.

Based on this re-evaluation of the data, the risks associated with the residential receptor are most likely overestimated based on the assumptions used to obtain the dataset used to evaluate risk. Based on the current configuration of residential areas adjacent to the Site and the future land use presented in the Ashland Wisconsin Waterfront Development Plan, risks to residential receptors would only be associated with surface soil exposures. Surface soil carcinogenic and noncarcinogenic risks are within USEPA's target risk range.

6.2.2 Indoor Air Evaluation

Based on the data collected, the indoor air concentrations were as much as an order of magnitude higher than the air concentrations detected in ambient air or soil gas samples. This suggests that vapor intrusion may not be primary source of VOCs detected in the indoor samples. However, because of the nature of the chemicals detected in indoor air samples, ambient air, and soil gas samples, the chemicals detected are somewhat dissimilar (**Table 19**). The chemicals detected in indoor air samples include chemicals that may be associated with solvents rather than chemicals that have been associated with historic activities at the site. There is the possibility that there may be other sources of VOCs within the former MGP facility buildings that may have contributed to the types of chemicals detected in indoor samples. As a conservative measure, all chemicals detected in the indoor air samples were included in the quantitative evaluation and the results of the evaluation suggest that risks to residents are within acceptable USEPA limits.

An HI of 3 was calculated for the worker exposure to indoor air pathway under the RME scenario. This risk level is likely to be an over-estimate because:

- It was estimated using the maximum detected concentrations as the concentrations at points of exposure.
- It was calculated based on the exposure parameters for the industrial/commercial workers (i.e., .an individual works at the Site for 8 hours per day, 5 days per week, 50 weeks per year for a total of 25 years). The NSPW Service Center where the indoor air samples were collected, is used as a warehouse; there is an office space inside the building, but used only on a part-time basis.

6.3 EXPOSURE ASSESSMENT

6.3.1 Exposure Scenario Assumptions

The assumptions used to identify the exposure scenarios evaluated in the HHRA were based on USEPA guidance, Site history, current land use, and limited information concerning future use of the Site. It is assumed that the primary exposure scenario is recreational for Kreher Park. Based on this land use, other scenarios (maintenance and construction) and pathways were developed. If the City of Ashland changes its decision to expand the recreational areas in the future, the HHRA may need to be revisited to determine the risks associated with the future land use.

6.3.2 Fate and Transport Assumptions

6.3.2.1 Volatilization Factors

Site-specific values needed for calculating volatilization factors (VFs) were unavailable. Therefore, chemical and physical parameters were selected from default values recommended in known literature sources based on the predominant soil type of silty clay. Using this approach to calculate Site-specific VFs may potentially result in an over- or under-estimate of risks if the actual Site-specific chemical and physical parameters are significantly different from default values selected based on the silty clay soil type.

6.3.2.2 Particulate Emission Factors

For the general industrial worker and residential scenarios, it was assumed that the inhalation of fugitive dusts generated by wind erosion was of concern. To estimate risks to this pathway, a particulate emission factor (PEF) is needed to relate the chemical concentration in soil to the concentration of dust particles in the air. For this HHRA, Site-specific values for the wind erosion dispersion factor and non-erodible surface cover were used for the residential and commercial/industrial scenarios. Because the non-erodible surface cover is based on current conditions, the risks estimated may not be representative of conditions with greater or lesser surface cover after the Site is developed for re-use.

For the construction scenario, the PEF was estimated using a combination of default and Site-specific information. USEPA's Supplemental SSL Guidance (USEPA, 2002a) was followed to estimate a PEF for both fugitive dusts associated with vehicular traffic on unpaved roads and for any other construction related activities (e.g., grading, dozing, tilling, wind erosion). Although it is assumed that future construction work will be limited to expansion of the Site as a recreational area, currently there are no plans in place for this work. Therefore, little Site-specific information exists concerning the actual construction activities that may occur. As such, a representative PEF for the Site could not be calculated and the actual PEF could be greater than or less than the estimated value.

Attachment G, Tables 1 through **14** present the PEF calculations for the commercial/industrial, residential, and construction scenarios. **Attachment G** also provides a detailed presentation of the default and limited Site-specific values used for the derivation of PEF values..

6.3.3 Receptor Exposure Parameter Values

Although there are future plans for expanding the recreational areas, specific information regarding construction and excavation activities that might occur is unknown. Therefore, risks to construction worker receptors based on the assumptions used in this HHRA may over- or under-restimate risks to this receptor population.

Additionally, little information is available concerning the maintenance work that is completed at the Site currently and none is available for future maintenance activities. The assumptions regarding the exposure frequency for maintenance workers is a based on

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seasonal weather patterns. The actual risks to this receptor are unknown but the estimates presented in this HHRA are based on conservative assumptions.

6.3.4 Exposure Point Concentrations

In general, EPCs used in the RME were based on statistically-derived concentrations calculated using USEPA's ProUCL software. However, for indoor air, two samples were collected for the purpose of evaluating risk to potential receptors. Because a UCL could not be calculated with only two samples, the maximum concentration was used as the EPC. Use of the maximum detected concentration may potentially overestimate risk associated with exposure to indoor air. However, the true risk is unknown.

6.3.5 Evaluation of Concentrations Exceeding Exceeding Csat

A separate evaluation was performed by characterizing risks using EPCs that were derived by excluding chemical concentrations in soil that exceeded the chemical-specific Csat. This evaluation was prepared in response to review comments on the draft HHRA report.

For the purpose of this evaluation, Csat values were calculated for chemicals that are in liquid form at the ambient soil temperature (55 degrees Fahrenheit). Chemical concentrations were compared to the Csat values and EPCs were derived by excluding concentrations that exceeded Csat values. Cumulative risks calculated using these EPCs are presented on **Tables 41** through **45**. Presented below is a comparison of the results of this evaluation to the risk evaluation using the entire soil dataset.

	EPCs Derived Based on the Entire Data Set		**EPCs Derived by Excluding Concentrations > Csat**	
	CR	HI	CR	HI
Residents (0-10 ft)/RME	5E-04	15	5E-04	14
Construction Worker (0-10 ft)/RME	1E-04	35	1E-04	33
Residents (0-10 ft)/CTE	2E-04	8	1E-04	4
Construction Worker (0-10 ft)/CTE	3E-05	13	2E-05	9
Residents (0-3 ft)/RME	5E-05	0.3	3E-04	0.9

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As indicated by this comparison, similar risk levels were calculated using EPCs derived based on all soil data in the relevant data sets or data that excluded concentrations exceeding Csat.

6.4 TOXICITY ASSESSMENT

6.4.1 Use of Unverified Toxicity Values

There were several chemicals (as presented in **Attachment A, Tables 1a and 1b)** detected at this site for which there are only provisional toxicity values. The USEPA process for developing provisional toxicity values is inherently conservative and is not subject to the same vigorous review process as toxicity criteria that have been verified. For this HHRA, 2-methylnaphthalene is a risk driver based on its provisional toxicity value. Because the toxicity values are based on limited animal and human data, the true risks associated with these chemicals is unknown.

6.4.2 Lack of toxicity Values for Detected Chemicals

There were several chemicals (1-methylnaphthalene, acenaphthylene, benzo[e]pyrene, benzo[g,h,i]perylene, phenanthrene, 1,2,3-trimethylbenzene, p-isopropyltoluene) that were detected at the Site and for which there are no toxicity values. Because of the lack of information available for these chemicals, the true risk to potential receptors at the Site is unknown. However, because these chemicals were detected in areas where primary risk drivers are located, it is likely that if any remediation based on known risk drivers will address chemicals for which there is a lack of toxicity data.

6.5 COMPARISON TO 1998 SEH BASELINE HHRA

In 1998, SEH completed a baseline HHRA for the Site and adjacent near shore sediments for the WDNR to evaluate the potential existing and future adverse health effects caused by hazardous substance releases from the Site in the absence of any actions to control or mitigate the releases. The current HHRA was completed as part of the requirements for the investigation of a Superfund site.

6.5.1 Comparison of Media of Interest

The 1998 SEH baseline HHRA identifies groundwater, seep water, surface water, surface soil, subsurface soil, sediment and fish tissue as the media of interest for receptors contacting impacted media at the Site. Since the completion of the 1998 SEH baseline

HHRA, two activities have impacted the media of interest for the Site. The results of these activities yielded the following changes to the media of interest for the Site:

- NSPW implemented interim removal actions in 2000 and 2002 to mitigate exposure risks to contaminants and to recover free-product from the deep aquifer. A low-flow pumping system currently extracts free-product from the deep aquifer, treating the entrained groundwater before discharging it to the City of Ashland's sanitary sewer.

- NSPW installed an extraction well at the base of the former filled ravine that was the source of the seep discharge at Kreher Park. This extraction well was part of a larger interim action that included excavation of contaminated materials at the former seep area and placement of a low-permeability cap to eliminate the intermittent seep discharge and mitigate environmental exposure of the associated contaminants.

Therefore, the exposure pathways associated with seep water (ingestion, inhalation and dermal absorption) identified in the 1998 SEH baseline HHRA are no longer complete.

6.5.2 Comparison of Exposure Areas

Both the 1998 SEH and the current HHRA divided the Site into subunits in order to group the data and more accurately assess the contaminants to which various populations may be exposed. However, the 1998 SEH HHRA did not address contamination associated with the former filled ravine, the location where some of the highest concentrations of Site-related chemicals have been observed in soil.

The 1998 SEH baseline HHRA exposure areas were limited to what is now identified as Kreher Park and the near shore area of Chequamegon Bay. Although the current HHRA does not specifically address a utility trench area for its worker population, it does include this area as part of the overall exposure area for workers. Because there are no definite re-use plans that have been developed for the Site, it was assumed in the current HHRA that maintenance and construction workers may potentially be exposed to soil throughout the entire Kreher Park area. Because the actual future exposure area is unknown, this approach is more conservative than the approach used in the 1998 SEH HHRA, as it assumes that workers may potentially contact impacted soil throughout the Kreher Park area.

6.5.3 Comparison of Receptors

In general, each HHRA evaluated similar receptors. Except for the trespassing scenario, the current HHRA is more comprehensive than the 1998 SHE HHRA as it includes receptors for the construction scenario as well as exposure pathways for industrial workers exposed to VOCs in indoor air and measured ambient air concentrations.

		1998 SEH HHRA		2007 HHRA	
Receptor Population	Medium	Current	Future	Current	Future
City Workers	Groundwater	Yes	Yes	No	No
	Seep Water	Yes	Yes	No	No
	Surface Soil	Yes	Yes	Yes	Yes
	Subsurface Soil	Yes	No	No	No
	Sediment	No	No	No	No
	Surface Water	No	No	No	No
	Fish	No	No	No	No
Recreational	Groundwater	No	Yes	No	No
	Seep Water	Yes	Yes	No	No
	Surface Soil	Yes	Yes	Yes	Yes
	Subsurface Soil	No	No	No	No
	Sediment	Yes	Yes	Yes	Yes
	Surface Water	Yes	Yes	Yes	Yes
	Fish	Yes	Yes	No	No
Fisherman	Groundwater	No	No	No	No
	Seep Water	No	No	No	No
	Surface Soil	No	No	No	No
	Subsurface Soil	No	No	No	No
	Sediment	No	No	No	No
	Surface Water	No	No	No	No
	Fish	No	No	Yes	Yes
Construction	Groundwater	No	No	No	No
	Seep Water	No	No	No	No
	Surface Soil	No	No	Yes	Yes
	Subsurface Soil	No	No	Yes	Yes
	Sediment	No	No	No	No
	Surface Water	No	No	No	No
	Fish	No	No	No	No
Adolescent Trespasser	Groundwater	No	No	No	No
	Seep Water	Yes	Yes	No	No
	Surface Soil	Yes	Yes	No	No
	Subsurface Soil	No	No	No	No
	Sediment	No	No	No	No
	Surface Water	No	No	No	No
	Fish	No	No	No	No

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Receptor Population	Medium	1998 SEH HHRA Current	1998 SEH HHRA Future	2007 HHRA Current	2007 HHRA Future
Residents	Groundwater (Indoor Air Only)	No	No	Yes	Yes
	Seep Water	No	No	No	No
	Surface Soil	No	No	Yes	Yes
	Subsurface Soil	No	No	Yes	Yes
	Sediment	No	No	No	No
	Surface Water	No	No	No	No
	Fish	No	No	No	No

The differences between the two HHRAs and how the overall risk estimated are affected are as outlined below:

- The 1998 baseline HHRA completed by SEH contained only a city worker exposed to groundwater, seep water, subsurface soils at the utility trench and surface soils on site and at the seep area. The current HHRA evaluates a general industrial worker and maintenance worker exposed to surface soil at Kreher Park and the Former MGP Site. The current HHRA does not address worker exposures to groundwater because neither the general industrial worker or maintenance worker will be associated with activities that would allow exposure to groundwater. Additionally, seep water exposure pathway is no longer complete because an interim response action was completed to cap the seep area. Although, the current HHRA does not evaluate worker exposure to subsurface soil, this HHRA does evaluate a construction worker exposure to soil to a maximum depth of 10 feet. The construction worker receptor is considered more conservative than the city worker exposed to subsoils at the utility trench and seep areas, because it incorporates soil data collected from the entire Kreher Park and Upper Bluff which are where some of the highest concentrations of chemicals have been detected.

- For the 1998 baseline HHRA completed by SEH, recreational receptors were considered for exposure to all media except groundwater. The current HHRA evaluates recreational receptors exposed to all media (except groundwater) but does not assume that all receptors will participate in activities that will allow exposures to all media. Separate receptors (swimmers. waders and recreational users) were evaluated for surface water, sediments, and surface soil exposures. In addition, fish ingestion was only evaluated for subsistence fisherman rather than as one of the pathway for a recreational scenario.

However, the risks based on the subsistence fisherman receptor as well as recreational exposures for each media can be summed to present risks in a fashion similar to that for the 1998 baseline HHRA. However, this was not part of the approved RI/FS workplan (URS, 2005). Differences in the cancer and noncancer risks estimated for both HHRAs are the results of the additional data that have been collected for the Site as part of the RI and in the manner in which the data were evaluated for inclusion in both HHRAs.

6.5.4 Comparison of Calculated Cancer and Noncancer Risk

In order to compare risks calculated for each HHRA, it is necessary to look at risks using a receptor and exposure scheme that is similar for both HHRAs. For this comparison, the comparison was completed using the receptors and exposure pathways identified in the RI/FS Work Plan (URS, 2005).

The table presented below shows that generally cancer and noncancer risks are within the USEPA target levels of 10^{-4} to 10^{-6} for cancer risks and 1 for noncancer risks. When there are calculated risks above USEPA target levels, they were generally for similar receptors (City worker exposed to subsurface soil and construction worker).

There are distinct differences between both HHRAs. These differences include:

- Residential receptors were not evaluated in the 1998 SEH baseline HHRA. No comparisons can be made for this land use scenario.

- Although evaluated for the 1998 SEH baseline HHRA, the seep has been capped and no longer represents a complete exposure pathway. Therefore, the risks estimated are no longer valid. With the elimination of this exposure medium the differences in the cancer and noncancer risks for recreational receptors exposed to media at Kreher Park, the comparison demonstrates that risks estimated in both HHRAs are similar and are within USEPA target range for cancer and noncancer risk.

- Although surface water was evaluated for the 1998 SEH baseline HHRA, there were no surface water COPCs identified using the current surface water dataset. Surface water risks estimated for the swimmers were less than the USEPA target HI less of 1. It is important to note that the current data set consists of high energy events (i.e., events likely to cause chemicals in the underlying sediment to resuspend Site-related chemicals to surface water) and low energy events (i.e., calm water) that were collected to verify the presence or absence of surface water contamination.

- The 1998 SEH HHRA identify only noncarcinogens as COPCs and noncancer risk was less than 1 for all receptors. The comparison to the current HHRA should be reviewed with the understanding that an adequate comparison cannot be made between the two sets of data based on the types of COPCs identified for each.

- The differences between the risks estimated for ingestion of fish are most likely because the 1998 SEH baseline HHRA used modeling to develop fish tissue EPCs using surface water data. The current HHRA uses actual fish tissue data to estimate risk and is more representative of Site conditions.

Uncertainty Analysis

	1998 SEH Baseline HHRA								2007 HHRA								
	SS		SD		SW		FISH		SS		SD		SW	FISH		Indoor Air	
Receptor[a, b]	**CR**	**HI**	**CR**	**HI**	**CR**	**HI**	**CR**	**HI**	**CR**	**HI**	**CR**	**HI**	**CR**	**CR**	**HI**	**CR**	**HI**
Resident	NE	NE	NE	NE	NE	NE	NE	NE	**5×10^{-4}**	**15**	NA	NA	NA	NA	NA	NA	NA
Recreational Adult	–	0.0006	NA	NA	NA	NA	NA	NA	3×10^{-6}	0.002	NA	NA	NA	NA	NA	NA	NA
Recreational Adolescent	–	0.02	NA	NA	NA	NA	NA	NA	2×10^{-6}	0.003	NA	NA	NA	NA	NA	NA	NA
Recreational Child	–	0.06	3×10^{-5}	0.7	–	5×10^{-5}	NA	NA	1×10^{-5}	0.04	NA	NA	NA	NA	NA	NA	NA
Adult Swimmer	NA	NA	3×10^{-5}	0.1	–	9×10^{-6}	NA	NA	NA	NA	5×10^{-9}	2×10^{-5}	NA	NA	NA	NA	NA
Adolescent Swimmer	NA	NA	2×10^{-5}	0.3	–	2×10^{-5}	NA	NA	NA	NA	3×10^{-9}	2×10^{-5}	NA	NA	NA	NA	NA
Child Swimmer	NA	NA	–	0.7	–	5×10^{-5}	NA	NA	NE	NE	NE	NE	NE	NE	NE	NE	NE
Adult Wader	NA	NA	NE	NE	NE	NE	NA	NA	NA	NA	1×10^{-5}	0.002	NA	NA	NA	NA	NA
Adolescent Wader	NA	NA	NE	NE	NE	NE	NA	NA	NA	NA	5×10^{-6}	0.002	NA	NA	NA	NA	NA
Industrial Worker	1×10^{-5}	0.02	NA	NA	NA	NA	NA	NA	9×10^{-6}	0.007	NA	NA	NA	NE	NE	8×10^{-5}	**3**
Maintenance Worker	NE	NE	NA	NA	NA	NA	NA	NA	1×10^{-6}	0.001	NA	NA	NA	NE	NE	NE	NE
Construction Worker[c]	**4×10^{-4}**	0.5	NA	NA	NA	NA	NA	NA	**1×10^{-4}**	**35**	NA	NA	NA	NE	NE	NE	NE
Subsistence Fisher - Adult	NA	NA	NA	NA	NA	NA	–	0.5	NA	NA	NA	NA	NA	**1×10^{-4}**	0.01	NA	NA
Subsistence Fisher – Adol.	NA	NA	NA	NA	NA	NA	–	0.1	NE	NE	NE	NE	NA	NE	NE	NE	NE
Subsistence Fisher - Child	NA	NA	NA	NA	NA	NA	–	0.1	NE	NE	NE	NE	NA	NE	NE	NE	NE

[a] Because each HHRA evaluated different receptor populations, the risks presented above are for receptor populations that were standardardized based on the approved RI/FS Work Plan.
[b] Because the seep was capped during the 2002 interim response action, exposures to this medium are no longer complete and were not used in this comparison.
[c] Construction workers were not evaluated in the 1998 SEH baseline HHRA. The values presented for this worker represent the subsurface soil risks for City Workers.
SS – soil
SD – sediment
SW – surface water
NA – Not applicable. This is not a relevant exposure medium for this receptor. Refer to **Section 3.1.4** for a discussion of the receptors evaluated for the Site.
NE – Not evaluated. This receptor or exposure medium was not evaluated. A suitable equivalent population could not be determined.
Items in **bold** represent cancer and noncancer risks that are greater than USEPA target levels of 10^{-4} for cancer risks and 1 for noncancer risks.

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6.6 HOT SPOT ANALYSIS

A hot spot analysis was performed for the construction scenario using data collected in the vicinity of the Former Coal Tar Dump in Kreher Park. This evaluation was completed as a worse case evaluation of potential risks following exposures to elevated concentrations over a short duration when receptors are engaging in activities that may result in greater contact with soil.

A hot spot analysis was performed for the construction worker scenario using data collected near the former tar pit (TP-4, TP113, TP115, TP116, TP118, and TP119). The resulting cancer risk of 4E-06 is primarily attributed to benzo(a)pyrene (72%). Upon review of the data gathered for benzo(a)pyrene for the former tar pit, 8 samples with detectable concentrations ranging from 1,400 – 2,600 mg/kg between 2.5 and 5 feet bgs are the main contributors to the benzo(a)pyrene cancer risk. As a upperbound estimate of risks to a construction worker, the maximum detected concentrations of benzo(a)pyrene (3000 mg/kg) and naphthalene (37000 mg/kg) were also used to evaluate hot spot risk. The risks from ingestion and dermal contact with benzo(a)pyrene was 1.3E-03; the hazard index from ingestion, dermal contact, and inhalation of naphthalene was 972.

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6.7 QUANTIFICATION OF DERMAL EXPOSURE TO PAHs

There are no published dermal SFs available for any chemicals in any USEPA database. As indicated in Sections **4.2** and **4.3** of this HHRA, current USEPA guidance recommends converting oral SFs (an administered dose) using an gastrointestinal absorption factor to a dermal SF (an absorbed dose), if a chemical does not cause toxicological effects at the point of contact. However, based on literature evidence, PAHs have been shown to induce systemic toxicity and tumors at distant organs as well as point of contact. For this reason, the current default approach for extrapolating dermal SF values is not applicable to PAHs. Therefore, RAGS Part A (USEPA, 1989) and Part E (USEPA, 2004), only recommend a qualitative evaluation of the carcinogenic effects of PAHs. Although a quantitative evaluation for this pathway was completed in this HHRA, as requested by Agencies, the actual cancer risks associated with dermal exposure to PAHs are unknown.

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The results of the HHRA indicate that only three exposure pathways result in estimated risks exceed USEPA's target risk levels: residential exposure pathways (for soil depths between 0 and 3 feet or all soil depths to 10 feet bgs), construction worker exposure pathway (for soil depths between 0 and 10 feet) and worker exposures to indoor air. These include estimates for the RME scenarios for potential cancer risks (a CR greater than 10^{-4}), and non-cancer risks (greater than an HI of 1). These conclusions are based on assumed exposures to soil in the filled ravine area (for residential receptors) and the filled ravine, Upper Bluff and Kreher Park area (for construction worker receptors), and to indoor air samples collected at NSPW Service Center. Carcinogenic risks based on CTE scenarios indicate that only the residential receptor exposure to soil (all soil depths to 10 feet bgs) are estimated to be at 1 x 10^{-4}, the upper-end of the target risk range. Noncarcinogenic risks for the residential receptor (for all soil depths to 10 feet bgs) and risks associated with the construction scenario are within acceptable levels. However, residential receptor exposure to subsurface soil is not expected, given the current and potential future land use of the Site. For this Site, residential risks associated with exposures to surface soil (0 to 1 foot bgs) are within the target risk ranges.

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Although the results of the HHRA indicate risks for the construction workers under the RME conditions exceed USEPA's target risk levels, the assumptions used to estimate risks to this receptor were conservative and assumed the worst case. Given both the current and future land use of the Site, it is unlikely that construction workers would be exposed to soil in the filled ravine and Upper Bluff. The most likely scenario for the future construction worker is exposure to soil within 0 to 4 feet bgs in Kreher Park (a typical depth for the installation of underground utility corridors), as most activities associated with the implementation of the future land use would be associated with regrading, landscaping, and road or parking lot construction. Therefore, risks to this receptor population are most likely overstated in this HHRA.

An HI of 3 was calculated for the worker exposure to indoor air pathway under the RME conditions. This risk level is likely to be an over-estimate because:

- It was estimated using the maximum detected concentrations as the concentrations at points of exposure.
- It was calculated based on the exposure parameters for the industrial /commercial workers (i.e., .an individual works at the Site for 8 hours per day, 5 days per week, 50 weeks per year for a total of 25 years). The NSPW Service Center is used as a warehouse; there is an office space inside the building, but used only on a part-time basis.

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Risks to recreational users (surface soil), subsistence fishers (finfish), waders and swimmers (sediments), industrial workers (surface soil), and maintenance workers (surface soil) are all within USEPA's target risk range of 10^{-4} to 10^{-6} for lifetime cancer risk and a target HI of less than or equal to 1 for non-cancer risk.

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